THE UNIVERSITY OF ALBERTA

AN EVALUATIVE INVESTIGATION OF SELECTED ASPECTS OF AN INDUSTRIAL ARTS RESEARCH PROGRAM

by

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A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "An Evaluative Investigation of Selected Aspects of an Industrial Arts Research Program" submitted by Michael J. Dyrenfurth in partial fulfilment of the requirements for the degree of Master of Education.

ABSTRACT

The problem investigated by this study was to describe and evaluate five selected aspects representative of the Department of Industrial and Vocational Education's experimental research program. The aspects selected for investigation included instructional materials, instructional equipment, physical facilities, achievement measures, and reaction to the experimental research program.

The scope of the study was limited to the two schools, King Edward and Cartier McGee Junior High Schools during the period 1968-1970. The scope included the students enrolled in the Phase I and Phase II industrial arts classes in their respective schools. The instructors, also included, were informed of the nature of the study and cooperated fully.

The selected aspects, given in the sequence of investigation, required varied techniques of data collection. Information was gathered using student and instructor interviews, a description and assessment of the physical facilities of the experimental research laboratories, a comparison of instructional equipment, an instructional materials classification, and an analysis of achievement measures.

Resulting from these instruments were a minimum of two direct sources and one indirect source of information for each aspect investigated. These information sources and their indicated findings were then synthesized to yield the conclusions. Some of the conclusions are listed as follows:

1. A trend became evident that indicates a stereotyping of specific instructional material for specific purposes.

2. The physical facilities of the two experimental research laboratories were assessed and found to be significantly removed from a "model" laboratory status.

3. An equipment comparison indicated that although the experimental research laboratories were equipped as recommended by the Department of Education with respect to power tools, machines, and equipment, they required additional hand tools, machine accessories, and supporting equipment to make full use of the available equipment's potential.

4. The lack of planning was noted as characteristic of the achievement measurement program employed by the Phase I research team.

5. The major conclusion with respect to the research program involves the lack of a proposal for research, of planning, organization, and administration in the implementation of the experimental research program, and the neglect of some commitments originally agreed upon.

The purpose of the study is restated in the concluding statement, which emphasizes the importance of documentation and evaluation as elements by which "change" can truly result in "improvement."

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Chapter 1

The Problem

Orientation to the Problem

In 1962 the Division of Industrial and Vocational Education was established within the Faculty of Education of the Edmonton campus of the University of Alberta. The establishment of this Division (changed to Department in 1963) was a manifestation of the growing awareness of the increasing technological demands of our society; the increasing complexity, both technical and social, of our environment; and of the evidence indicating the exponential growth of technical knowledge. A further reason for the establishment of the Division was given in the annual Board of Governors Report 1961-1962 by the Dean of the Faculty of Education, Dr. H. T. Coutts.

> In response to a need created by substantial federal government assistance to vocational education, the General Faculty Council at its March meeting gave approval in principle to the establishing in the Faculty of Education a division of industrial and vocational education . . . (p. 29).

As described in the Board of Governors Report 1962-1963, the initial departmental functions centered upon the development of the program leading to the Bachelor of Education in Vocational Education degree and determining the role of industrial arts and vocational education in the junior and senior high school programs. By 1965 the

departmental functions had been further defined and were outlined in an unpublished Position Paper (Ziel, Tichenor, & Gallagher, 1965). The five basic areas of concern were:

1. The program leading to the Bachelor of Education in Inudstrial Arts degree. This is the preparatory program for Alberta's junior and senior high school industrial arts teachers.
2. The graduate programs leading to the Graduate Diploma and the Master of Education in Industrial Arts degree.
3. Using the Department's unique resources to provide service courses filling the needs of other departments and faculties.
4. The position of the Department as a leader in the development of an innovative industrial arts program.
5. The conducting of research programs in the field of industrial arts education.

This study focussed on the fifth and fourth departmental functions. The problem statement further identifies the study's approach and purpose.

Statement of the Problem

The problem investigated in this study was to describe and evaluate selected aspects representative of the experimental research program carried out by the Department of Industrial and Vocational Education during the years 1968 to 1970. The aspects selected for evaluation were; (a) instructional materials and teaching methods as they relate to

instructional material, (b) instructional equipment, (c) the physical facilities of the experimental research laboratories, (d) the evaluation of achievement, and (e) the administration of the experimental research program.

The purpose of this study was to provide information necessary for increasing the effectiveness of the department's experimental research program, thus providing feedback for the industrial arts teacher education program. In this way the study contributes information to the first, fourth, and fifth departmental functions.

Objectives

The following objectives were pursued in the investigation of the problem and its selected aspects.

1. To obtain information, about (a) teaching methods, (b) instructional material, (c) instructional equipment, (d) the evaluation of student achievement, and (e) individual opinions and reactions to the experimental research program, by interviewing the instructors of the experimental research program.
2. To obtain information about, (a) student reaction to the instructional materials used, and (b) student reaction to the experimental research program, by interviewing students enrolled in the experimental industrial arts program.
3. To describe and analyze the measures of achievement used by the staff of the experimental research

program (Phase I 1969-1970).

4. To describe and outline the physical facilities of the two experimental research laboratories in terms of the guidelines in Industrial Arts Laboratory Planning (Department of Education, 1968).

5. To assess the physical facilities of the two experimental research laboratories using the evaluative criteria developed in the United States of America (USA) by the National Study of Secondary School Evaluation (NSSSE).

The Need for the Study

The generalization, that evaluation is necessary for program development and improvement, is indicated in A Position Regarding the Meaning of Educational Evaluation, (Stufflebeam, 1967), in Evaluation as Feedback and Guide, (Association for Supervision and Curriculum Development, 1967), and in Evaluation Guidelines for Contemporary Industrial Arts Programs, (American Council on Industrial Arts Teacher Education, 1967).

In discussing needed research into industrial arts at the national level, Bauer (American Council on Industrial Arts Teacher Education, 1960) stated, "problems of . . . evaluation, guidance, the integration of subject areas, curricular relations and the like may well be included" (p. 103). Speaking in generalities, Van Tassel (American Council on Industrial Arts Teacher Education, 1960) identified

needed research with the following quotation.

> Improvements in the industrial arts programs can be made largely through scientific research. We must evaluate what we have done in the past, and what we are doing at present in order to determine where we are going in the future (p. 119).

This evidence supporting evaluative research at the national (USA) level was reflected at the provincial level in a statement made by Mr. J. D. Harder, Supervisor of Industrial Arts for the Department of Education of the Province of Alberta. Speaking at the 1967 Invitational Conference on Industrial Arts, Mr. Harder stated,

> The problem that recurrs to me often is how we can best evaluate the innovations made in reference to the declared objectives. What are the key factors that make the program most effective, is it the context, the equipment, the activity, the methods of communication? We really do not know (p. 96).

With respect to the Department of Industrial and Vocational Education's position on needed research, six areas have been identified in an unpublished Position Paper (Ziel, et al., 1965) as being "the most emergent areas in which we feel industrial arts research is feasible and would be of value . . ." (p. 25). One of the areas mentioned was evaluation.

From this brief review of some of the more pronounced comments regarding the development of programs, improvement, and evaluation, it is indicated that a need for evaluative studies exists at the national (USA), provincial (Alberta) and local (Department of Industrial and Vocational Education) levels. The review of the literature suggests the national

need is for both comparative and methodologically innovative studies, the provincial need is for the assessment of the effectiveness of the schools programs, and the local need centers around the further development and improvement of the Department's experimental research program and through this provide feedback and the opportunity to increase the effectiveness of the industrial arts teacher education program.

Operational Definitions

Industrial arts rationale. This phrase was used to refer to the ideas and concepts initially proposed by Dr. H. R. Ziel in describing an innovative industrial arts program. These ideas and concepts are documented in the Alberta Teachers Association Magazine, (Ziel, 1963), in Industrial Arts and Vocational Education, (Ziel, 1962b), and in the Alberta School Trustee, (Ziel, 1962a).

The four phases advocated in the proposed program are most succinctly described in Research Report I--Industrial Arts in General Education, (Ziel, Leblanc, & Manuel, 1966). Phase I centers on the study of tools, machines, materials, and processes; Phase II is the introduction to and the study of selected technologies; Phase III investigates the study of man and his relationships to technological demands; and Phase IV involves the in depth study of a cluster of technologies.

Industrial arts teacher education program. This phrase refers to the program of studies leading to the degrees of Bachelor of Education in Industrial Arts and Master of Education in Industrial Arts, both offered at the University of Alberta at Edmonton.

Experimental industrial arts program. This phrase refers to the program of activities undertaken by the students enrolled in industrial arts courses at King Edward and Cartier McGee Junior High Schools. While both of these schools are located in Edmonton, the former is operated by the Edmonton Public School System while the latter is operated by the Edmonton Separate School System, predominately Roman Catholic in religion.

Experimental research laboratories. This phrase refers to the industrial arts laboratories at the King Edward and Cartier McGee Junior High Schools (JHS). The King Edward laboratory was used to teach Phase I of the experimental industrial arts program.

While the Cartier McGee laboratory is equipped for both Phase I and II, only the Phase II section was involved with the experimental industrial arts program.

The Phase I and II laboratories at King Edward and Cartier McGee schools have both been partially equipped by the University of Alberta's Department of Industrial and Vocational Education, with the balance of the equipment supplied by the respective school systems.

Experimental research program. This phrase is used to indicate the activities of the University of Alberta's Department of Industrial and Vocational Education's research staff. These activities include efforts toward curriculum development, testing, and laboratory organization. Figures 1 and 2 give the organizational structure of the research staff during the two years the study focussed upon. The research program commitments between the Department of Industrial and Vocational Education and the Edmonton school systems are detailed in appendix A. A compilation of the objectives for the research program is given by appendix B. For this compilation, no one specific source was used, for none was found, but rather a number of sources both formal and informal were used to discover the objectives.

Assumptions

1. That the experimental research program and the activities involved reflect the ideas of the industrial arts rationale.
2. That with some modification the evaluative model(s) used by other innovative industrial arts programs can be applied to the experimental research program.
3. That the aspects selected to be evaluated are representative of the experimental research program.
4. That the experimental research laboratories were intended to become "model" industrial arts facilities.
5. That the responses of the students and instructors

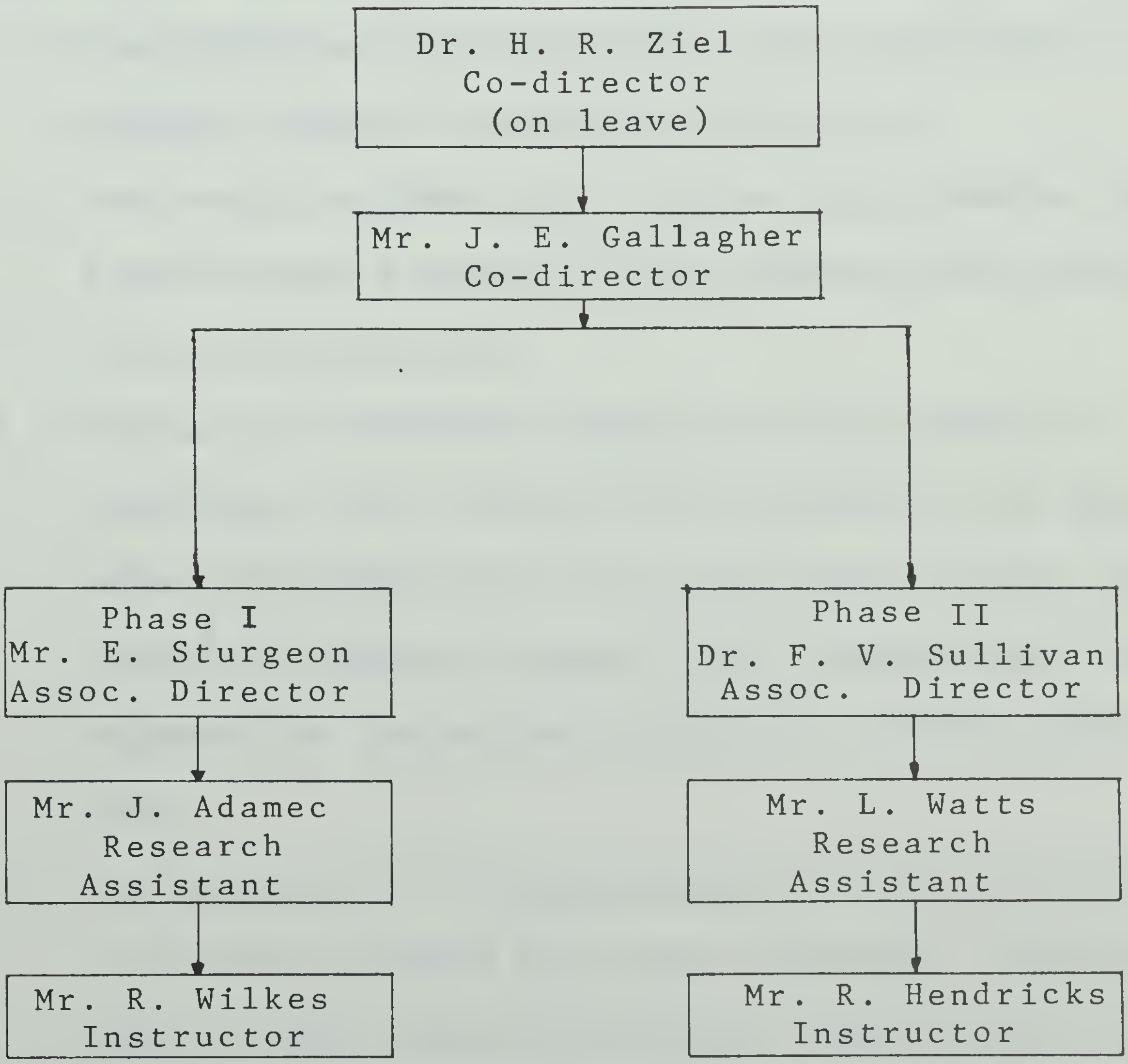

Fig. 1 The organizational structure of the experimental research, 1968-1969.

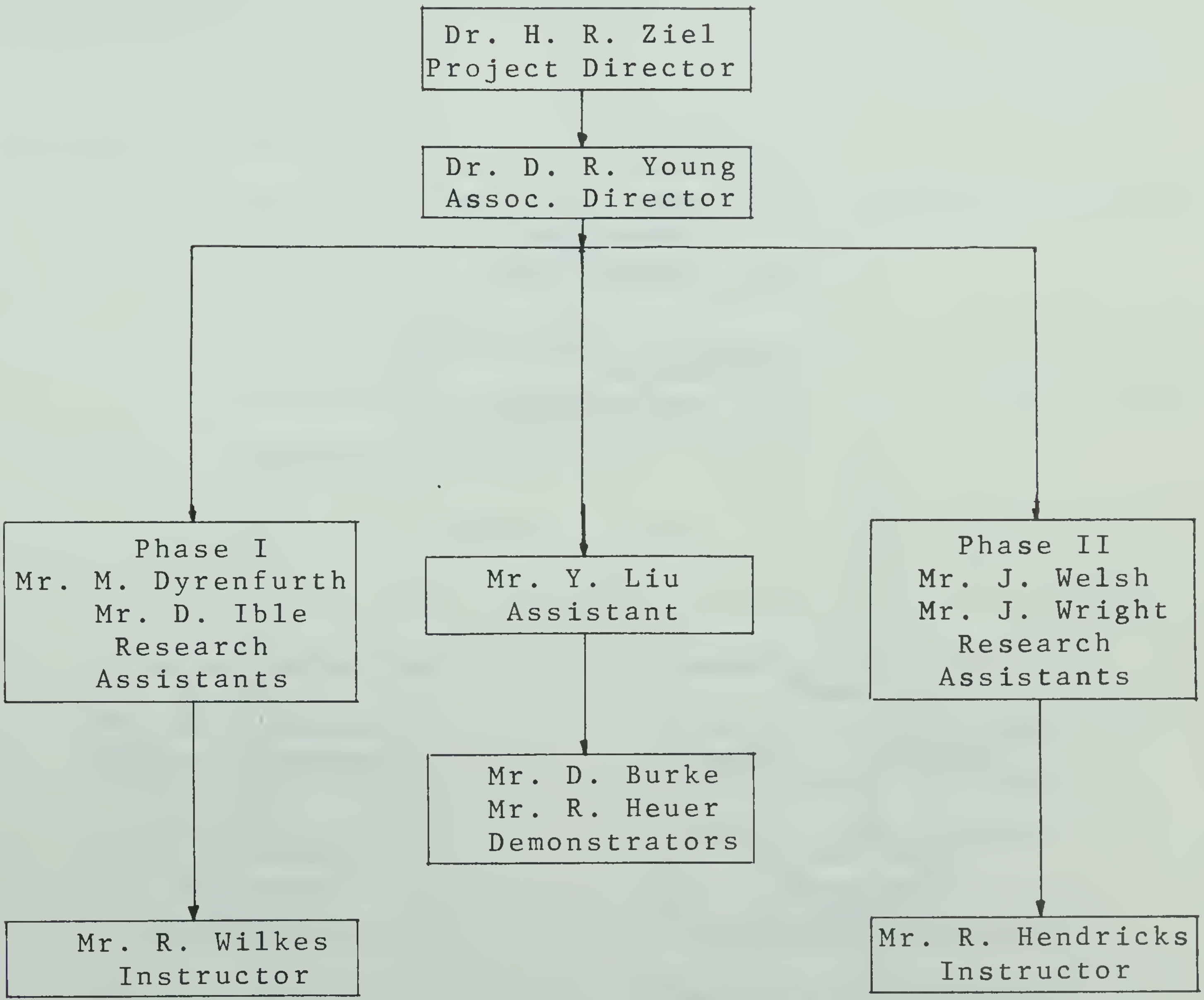

Fig. 2 The organizational structure of the experimental research staff, 1969-1970.

to interview questions were candid and unbiased.

6. That the NSSSE checklist (as modified) is applicable to the experimental research laboratories.

Delimitations

For the purposes of this study, the following items determined the scope of the investigation:

1. The study was concerned with the experimental research program during the period, 1968-1970.
2. The study included only the two experimental research laboratories located at King Edward and Cartier McGee Junior High Schools.
3. The major innovative programs in the field of industrial arts, which were selected to be reviewed, were the Industrial Arts Curriculum Project, the American Industry Project, the Orchestrated Systems approach to Industrial Education, and the Maryland Plan.
4. The aspects of the experimental research program that were selected for study included, instructional material and teaching methods, instructional equipment, physical facilities, achievement measures, and research administration and activities.

Limitations

The limitations upon the study were classified into two categories as follows:

1. Those personal limitations of the researcher involving

such factors as expertise, time, and finances.

2. The availability of information accurately describing the Department of Industrial and Vocational Education's research program.

Chapter 2

Related Literature

Since this study centered upon the research program of a relatively new approach to industrial arts, an investigation of other innovative industrial arts programs and their evaluative models, instruments, and procedures was necessary.

Sources

Many of the materials used to describe and report the evaluation processes of innovative programs are unpublished. Generally, they are papers read at conferences, seminars, the results of symposiums, etc. Sources such as books and periodicals, although consulted as references where applicable, had limited value for the purposes of obtaining current information for specific programs.

As an alternate source, the Educational Research Information Center (ERIC) system was used extensively to determine activity in the field. The use of this retrieval system of abstracts and micro-fiche, provided access to a large amount of material that would normally not be available.

Selection of Innovative Programs

The innovative programs reviewed and investigated were, the American Industry Project (Face & Flug, 1968), the

Functions of Industry Approach (Bateson & Stern, 1963), the Galaxy Plan (Turnquist, 1965), the Industrial Arts Curriculum Project (Towers, Lux, & Ray, 1967), Industriology (Kirby, 1967), the Maine State Plan (Mitchell), the Maryland Plan (Maley), the Orchestrated Systems Approach (Yoho, 1967), the Partnership Project (Minelli), and the Alberta Plan, which for the purposes of this study was termed the industrial arts rationale.

Of these programs, using the criterion of available published materials, the most advanced in terms of implementation appear to be, the American Industry Project, the Industrial Arts Curriculum Project, the Maryland Plan, and the Orchestrated Systems Approach to Industrial Education.

These four programs appear to be leaders in the field as evidenced by their inclusion in both the <u>Guild News</u> (Industrial Education Guild, 1968) and the 54th Mississippi Valley Industrial Arts Conference (Lux, 1967). Both of these sources were particularly concerned with innovative programs in industrial arts. Another source, <u>Innovative Programs in Industrial Education</u> (Cochran, 1970) also identified these programs with those he classed as "innovative." As a result of the evidence indicating the importance of these four programs, they were further investigated in terms of evaluative procedures and models.

Evaluation and the Orchestrated Systems Approach

A detailed search and investigation of the

Orchestrated Systems Approach failed to yield any information regarding evaluative procedures and instruments. In the unpublished booklets, The Orchestrated Systems Approach to Industrial Education (1967) and The Systems Analysis Approach to Industrial Arts Content (1969) Yoho makes no mention of an evaluative model or procedure. This fact was later substantiated during an informal interview by the researcher at the 1970 American Industrial Arts Association convention.

Evaluation and the American Industry Project

The American Industry Project's (AIP) evaluation system is probably the most widely distributed industrial arts program evaluation system presently available. The booklets, American Industry Project: Development and Evaluation (1967) and the Evaluation System for the American Industry Secondary School Courses (1968) both authored by Dr. O. Nelson, provide much information describing the system, and they permit an analysis of the AIP evaluative procedures.

The scope or domains of the evaluation system are clearly shown in figure 3. The system "was designed to generate several types of data" (Nelson, 1967, p. 9) as follows:

1. Essential information (feedback) for making operating decisions.
2. Data to accumulate and form a history of the project.
3. Data to assess the congruence of the objectives and of the activities designed to reach those goals.

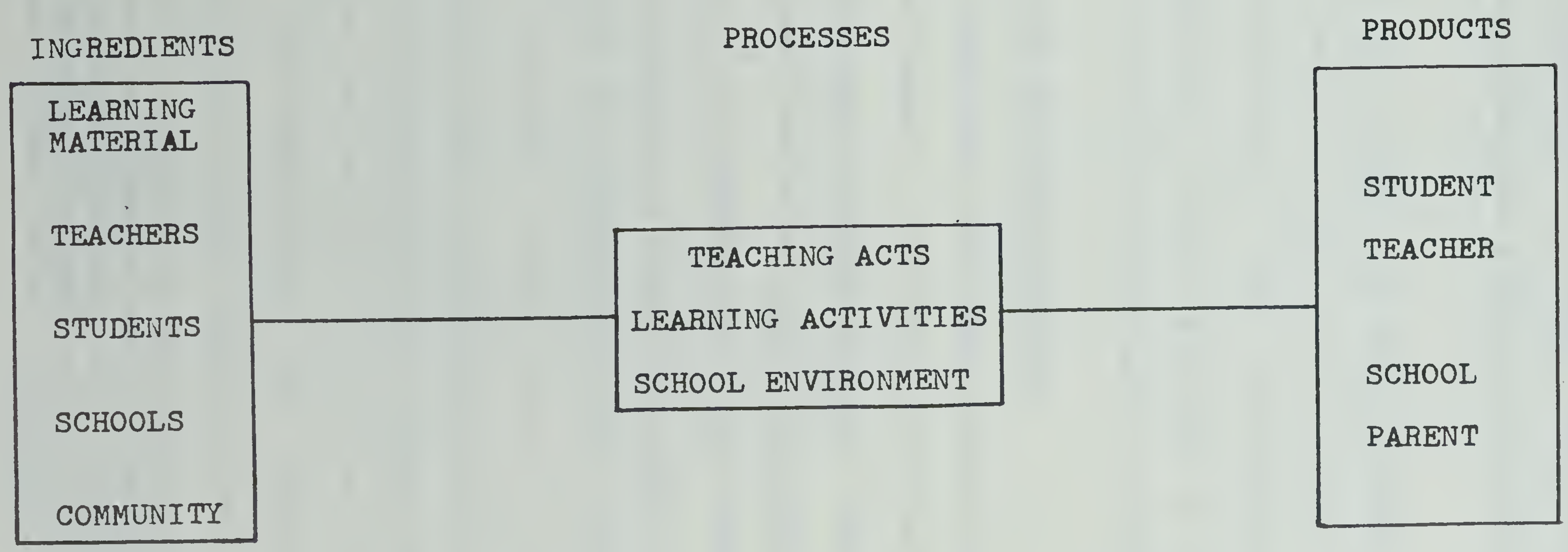

Figure 3

EVALUATION DOMAINS IN THE AMERICAN INDUSTRY PROJECT

(Nelson, 1968, p. 9)

In addition to this descriptive data, the AIP's evaluation system also provided comparative data upon which decisions regarding the effect of the AIP curriculum could be made.

For this study, the most valuable aspect of the AIP evaluation system is the model it presents to describe the domains of evaluation. With some modifications this model will be applicable to the Department of Industrial and Vocational Education's experimental research program.

Evaluation and the Maryland Plan

The Maryland (MP) plan, advanced by Dr. D. Maley in the article "Research and experimentation in the junior high school" (*The Industrial Arts Teacher*, March 1959) and in the two unpublished booklets, *Industrial Arts--A Study of Industry and Technology for Contemporary Man* (Maley) and *The Junior High School Program in Industrial Arts--A Study of Industry and Technology for Contemporary Man* (Maley), utilizes the "behavioral analysis" process as an evaluative technique. In *The Maryland Plan for Industrial Arts in the Junior High School and the Behavioral Task Analysis Approach*, a presentation given at the National Convention of the American Industrial Arts Association, 1969, Maley stated the purpose of the behavioral analysis approach was:

> To provide a system for describing possible outcomes that could be observed and at the same time have a one-to-one relationship with the projected goals. This step was vital since its application dealt with that very important process called *evaluation* (p. 5).

Maley (1969) goes on to state,

> The fourth phase in the development of the Maryland Plan was to determine the extent to which the goals were attained. This was accomplished by applying the "behavioral analysis" technique (p. 20).

Figure 4 illustrates the evaluation process used by Maley. The process resembles the approach initiated by R. W. Tyler (1934), elements of which are detailed more recently by R. F. Mager (1962). This approach involves the stating of objectives in behavioral terms, converting these terms into measuring instruments, and then collecting data resulting from the application of the instrument.

The Maryland Plan's evaluative system centers around the procedure used to obtain clear descriptions of goals and objectives at first, and then it attempts to determine the congruence of the actual situation with the objectives. Essentially, this is the heart of all evaluation.

Evaluation and the Industrial Arts Curriculum Project

Using a slightly different approach, the Industrial Arts Curriculum Project (IACP) has established three phases in their evaluation program (Towers, Lux, and Ray, 1966); "(a) the measurement of behavior change or goal attainment, (b) the evaluation of the effectiveness of instructional procedures, and (c) evaluation of the appropriateness of the objectives" (p. 301).

The first phase, the measurement of behavior change provides information to:

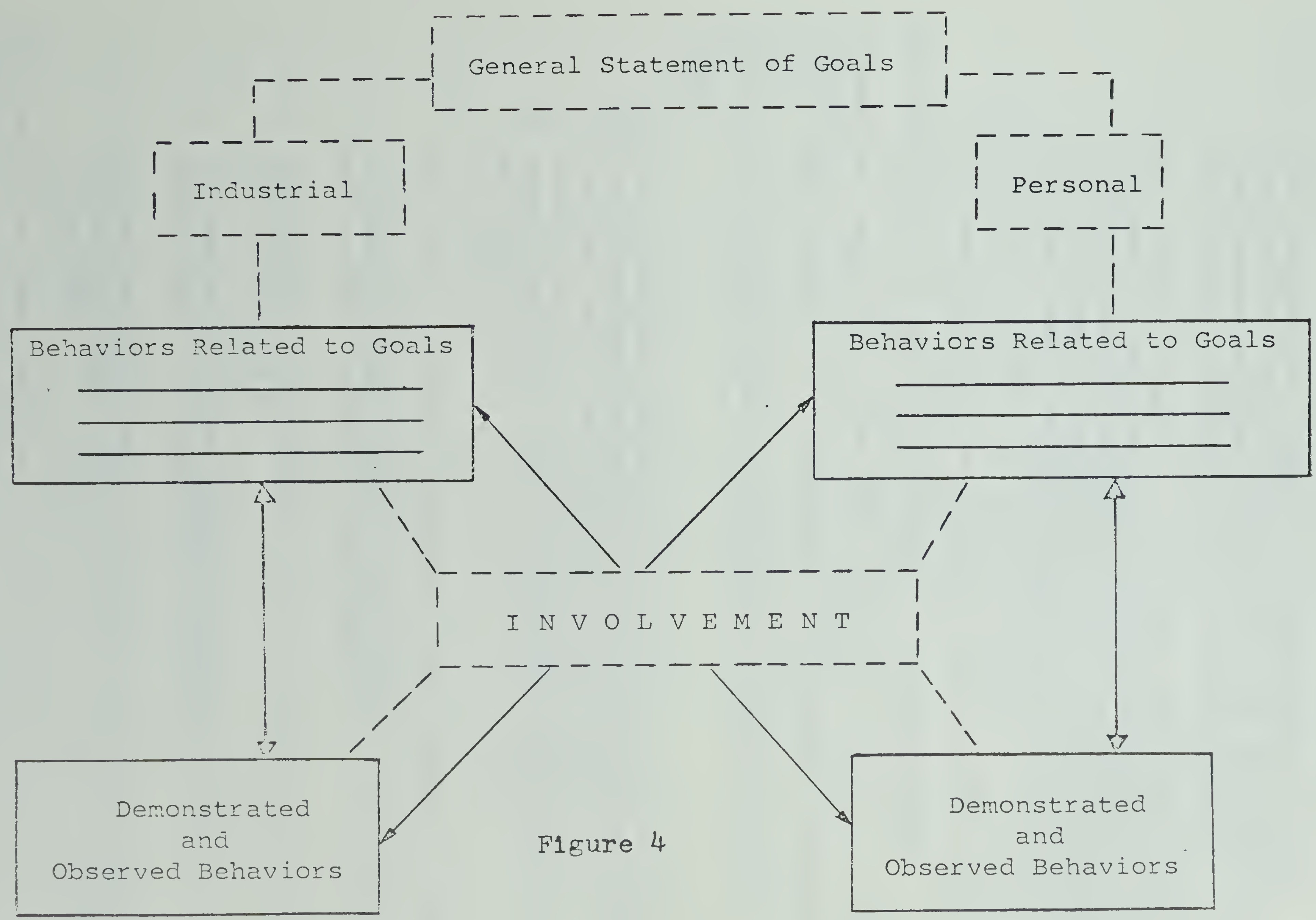

Figure 4

FOURTH - PHASE, EVALUATION PROCESS TO DETERMINE THE ATTAINMENT OF GOALS
(Maley, 1969)

1. The learner, who makes judgments as to the appropriateness of his previous behavior.

2. The teacher . . . makes a judgement as to the appropriateness of his behavior and is either reinforced or else becomes aware of the fact that his teaching behavior was not satisfactory.

3. The project staff . . . to make additional value judgements concerning the appropriateness of various instructional procedures and the appropriateness of the objectives themselves, and to make recommendations for the next time this objective is implemented (Towers, et al., 1966, p. 302-303).

In developing the second and third phases, that is, the evaluation of the effectiveness of instructional procedures especially, the IACP uses many sources of information. They attempt to incorporate "five primary sources" of data in the second phase of evaluation (Towers, et al., 1966):

(a) data from the field or pilot test of a procedure,
(b) test data that measures if the objective was met,
(c) teacher data that reflects student feedback as to their level of interest and involvement, and
(d) supervisory data that is feedback from supervisors, administrators, and project staff members . . . (p. 305).

This data is then analyzed in four manners to obtain:

1. A check on the validity, reliability, and useability of the data gathering instruments.

2. An analysis of observed and felt student interests and involvement.

3. An analysis of the appropriateness of methods and materials for a particular objective.

4. An analysis of teacher behaviors to see if the teacher actually used behaviors that were intended to be used . . . (Towers, et al., 1965, p. 305).

This analysis then provides for the evaluation of the appropriateness of the activity for a particular objective.

The evaluation of the appropriateness of the objectives, IACP's third phase of evaluation;

> First involves a check as to whether this objective was sound in terms of its relation to higher-level objectives . . . and whether it was logical in terms of the subject matter, skill, or behavior it stood for. The third question is a judgement as to its measureability. Was it possible to test for this particular objective through valid test items, or was the behavior so vague that the validity can only be hoped for and not demonstrated through replication of a specific behavior? After these checks are made, and at various stages in these checks, decisions are made to accept or reject an objective (Towers, et al., 1966, p. 307).

By developing the second and third phases of their evaluation system, the IACP has progressed past the AIP and the MP evaluation systems. The best indicators of this are the two models shown in figures 5 and 6. These models illustrate the procedures used to accomplish the evaluation. As these models were constructed for purposes of curriculum development as well as for evaluation, they share a similarity of purpose with the research program of the University of Alberta's Department of Industrial and Vocational Education.

Although the thoroughness of the IACP evaluation technique is quite evident, in the available literature, they provide little information describing the instruments used. The main emphasis appears to be on providing an outline or structure of what is to be done.

Other Evaluative Studies

In addition to the literature associated with the innovative industrial arts programs, literature surveying the field of evaluation was also reviewed. Of major

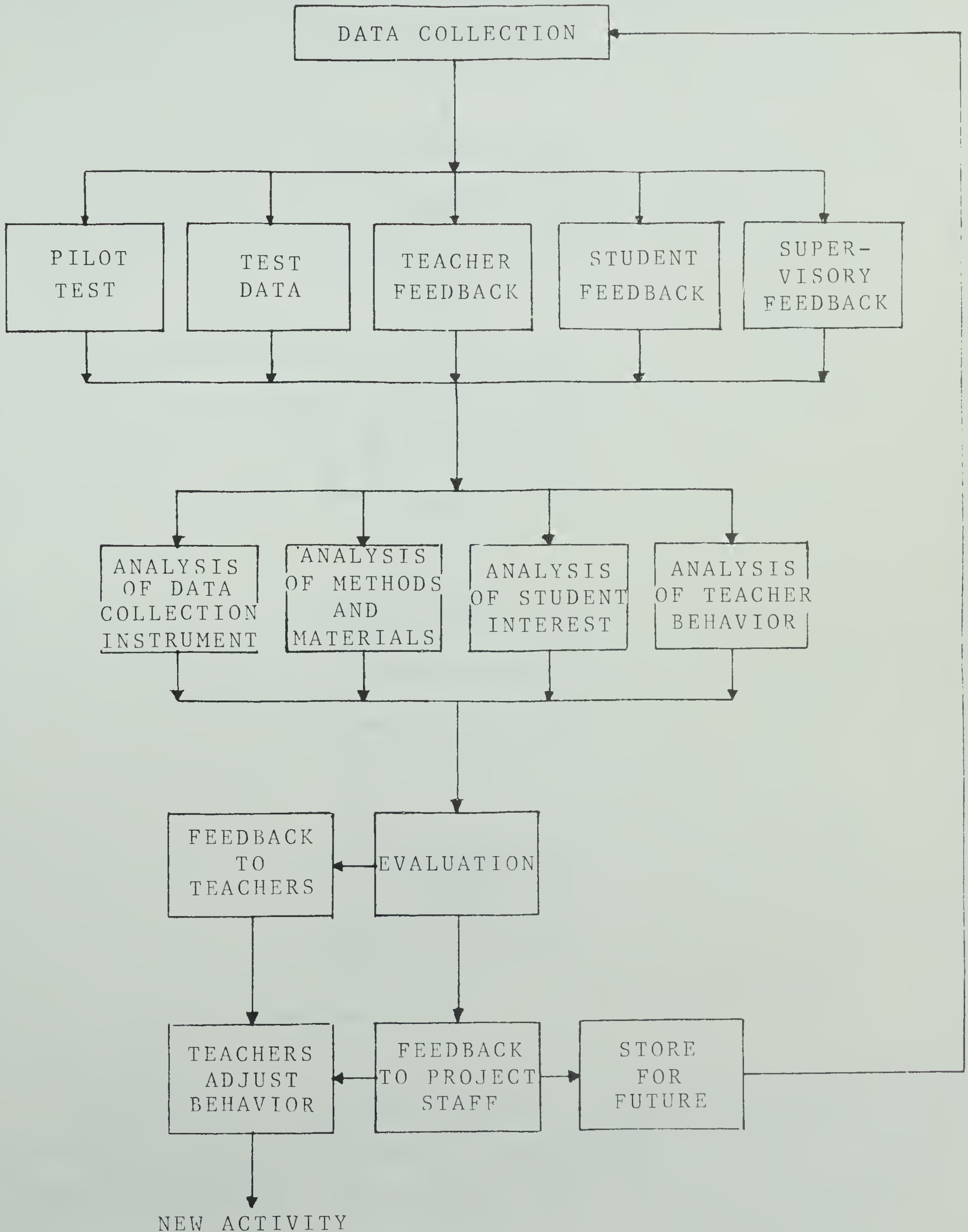

Figure 5

EVALUATION OF PROCEDURES (IACP)

(Towers, et al., 1966)

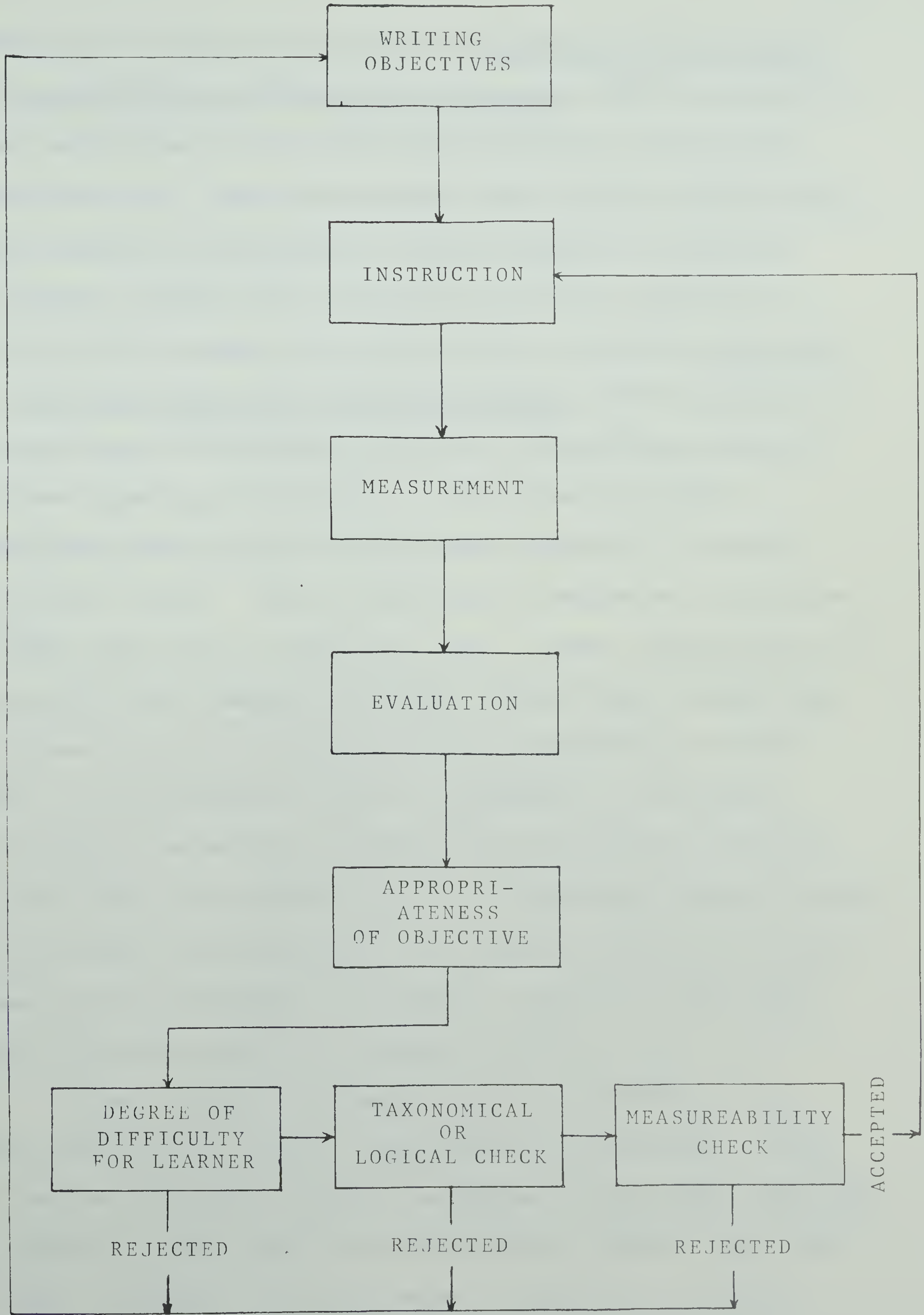

Figure 6

EVALUATION OF APPROPRIATENESS OF OBJECTIVES (IACP)

(Towers, *et al.*, 1966)

importance in this category was the Annotated Bibliography on the Evaluation of Educational Programs (1968) prepared by Eidel and Klebe for the ERIC Clearinghouse on Educational Administration. The bibliography lists recent (mostly 1964-1968) sources on evaluation, with an emphasis on methods, procedures, models, and exemplars of program evaluation. Another survey source consulted was the document, Evaluation in Vocational Education, Research Summary (1967) produced by the California Coordinating Unit for Occupational Research and Development at Sacramento. The summary provides capsulated descriptions of evaluative research in several vocational fields. Their definition of vocational education includes the area of industrial arts. These descriptions of industrial arts research projects provided many suggestions and ideas that were considered in the conducting of this study. The Coordinating Unit's statement of the uses of evaluation is especially concise and the purposes and hope of this study are reflected by it. "Evaluation helps identify the strengths and weaknesses of a research project, and thus leads to the development of plans of action by which weaknesses discovered may be corrected (1967, p. 1).

These survey instruments lead to a review of the models used in the various approaches to evaluation. From the review, it appears that in addition to the often referred to models of Stake (1967) and Stufflebeam (1968), there are a number of lesser known but equally interesting models. Examples are the discrepency model (Provus, 1969), the

curriculum hierarchy for evaluating course knowledge (CHECK) technique and model described by Tuckman (1967), and the systems approach of Alkin's (1967). Adams, in a booklet entitled *A Planning Project to Develop New/Improved Techniques and Procedures for Evaluating Elementary and Secondary Schools, Final Report* (1969), describes a six phase project designed to develop even more models for evaluation.

All of the models mentioned, share a similarity of purpose, in that evaluation is felt to be a process for, "program development and stabilization as well as a means of assessment" (Provus, 1969, p. 9).

Summary

This review of evaluative efforts is indicative of the diversity of thought and action in the field. Although opinions are varied, consensus is achieved on the point that evaluation must be constructive in nature. Each of the industrial arts programs has something to offer with respect to evaluation. The AIP model, by depicting the domains of evaluation suggests *what* to look for; the MP's "behavioral task analysis" provides a means of *determining* objectives; and the IACP has developed *procedures* for evaluating objectives and classroom activities. The study of these aspects will provide guidelines for the Department of Industrial and Vocational Education's experimental research program in the future.

The similarity between the researcher's interpretation

of the purpose and definition of evaluation, and those interpretations identified by other researchers is also noted. The common use of models to provide structure to the evaluative process is recognized, and its value acknowledged by the researcher.

Chapter 3

The Procedures

Introduction to the Procedures

The choice of procedures used by the researcher was influenced by the limited time available to the researcher for investigations requiring access to the experimental research laboratories. Additionally, the phasing-out of the experimental research program was imminent (Coutts, 1970). In order to maximize the situation's value, measures and techniques had to be employed that required a minimum of time for implementation and yet return a maximum of information pertinent to the study's objectives.

The Population

The Department of Industrial and Vocational Education's experimental research program was in operation at two schools. The Phase I laboratory was located at King Edward Junior High School and the Phase II laboratory was located at Cartier McGee Junior High School.

The King Edward laboratory served eight and ninth grade students from Garneau, King Edward, and Parkallen Junior High Schools, all of which are in the Edmonton Public School System. Mr. R. Wilkes was the instructor responsible for the instruction of these students.

The Cartier McGee laboratory served only its own

students, and Mr. R. Hendricks was the instructor responsible for their instruction. Cartier McGee's laboratory is equipped for both Phase I and Phase II but the experimental research program involved only the Phase II section.

Each laboratory served to provide instruction to a predominately male student population. In approximate (approximate because enrollment fluctuates during the year) numbers, the King Edward laboratory served 120 students and the Cartier McGee laboratory served 60 students (in the experimental research program). It was these schools, their laboratories, staff, and pupils, that formed the population for this study.

The Sample

A sample size of approximately one third of the total student enrollment (172, June 1970) in the experimental industrial arts program was decided upon by considering the variables of group size, class size, and the available time. The literature was consulted to determine the respective advantages and disadvantages of group and individual interviews. No great advantages or disadvantages were found, although Merton, Fiske, & Kendall (1956) do support the group interview with:

> On balance, it appears that the advantages of the focussed (interview of groups) more than offsets its disadvantages when one seeks clues to diverse definitions of the situation by a numerous body of individuals (p. 135).

It was then decided that a group interview would

best suit the demands of time, and also provide a greater amount of information due to interactions within the group.

The required sample from each class was selected using the following sequence:

1. First, the total class enrollment was determined.
2. The sample size (1/3) was then calculated. If this resulted in a non-integral number, the sample size was taken to the next nearest integer.
3. Using the random number tables (p. 446-450) in Dixon and Massey's Introduction to Statistical Analysis (1969), and following their suggested technique (p. 40), the required number of random numbers, ranging from 1 to the class size, was selected. If a duplication occurred, it was ignored and another number was selected.
4. The sample of numbers was then compared to the class register and the actual student selection was then made.

In this study, a sampling and consequently a sampling technique, was only necessary for the achievement of the second objective (interviewing students). All of the other devices and methods used to gather data pertaining to the remaining objectives were applied to the total population rather than to a sample of selected elements.

Research Design

The nature of the research design is "ex post facto."

Because the study intended to evaluate selected aspects of a research program that was already completed, the normal design approaches developed for experimental procedures were not applicable.

The researcher would suggest that the overall design employed for the study was a developmental and descriptive one, arising out of a particular situation and leading to or suggesting a procedure useful in future evaluative efforts. The process employed stems from the nature of evaluation:

1. A situation exists or will exist about which information as to its effectiveness and efficiency is desired.
2. Major aspects which provide an indication of the effectiveness and efficiency are selected.
3. Devices are selected, modified, or developed to measure these aspects.
4. The results of the application of the devices are analyzed.
5. Conclusions are drawn and recommendations are made.

Table 1 list the instruments and devices employed for the investigation and each instrument's contribution, with respect to the aspects studied. Each aspect has at least two direct sources of information resulting from the instruments, and most aspects have other indirect inputs of information as well.

Table 1

Information Yield of Instruments used in the Investigation of the Selected Aspects

Instrument or Device	Investigated Aspects				
	Instructional Materials and Teaching Methods	Physical Facility	Achievement Measures	Instructional Equipment	Research Program
Instructor Interview	YDI	ID	YDI	YDI	YDI
Student Interview	YDI ID	ID	YDI	ID	YDI
Description of Physical Facility		YDI			
Assessment of Physical Facility		YDI			
Equipment Comparison				YDI	
Instructional Materials Classification	YDI				
Application of Criteria			YDI		

Abbreviation code: YDI--yields direct information, includes questions directly concerning this aspect. ID--indirect yield of information, responses concerning this aspect may result, but not from a direct question.

Instrumentation

Instructor Interview

The instructor interview was conducted in an informal manner using an interview guide to outline the question areas. In order to obtain the necessary rapport required to make such an interview most productive, an orientation was required. This orientation served the purposes of:

1. Providing a common frame of reference to the instructors that were interviewed.
2. Providing the instructors with pertinent information thus enabling them to make their own decisions as to the worth of the study.

Orientation. The instructor orientation was constructed to achieve the above two objectives. The effect planned was to create positive motivation towards the study and the interview. The orientation consisted of operational definitions related to the questions asked; the purposes of the study, both academic and personal; a list of pertinent information assisting in recall; and an indication of the period of time the study dealt with. Both the orientation and the interview guide used in this study are given in appendix D.

Interview guide. The interview guide outlined the question areas of concern to the study. The question items were constructed to provide information, both descriptive

and evaluative, pertinent to the selected aspects that were studied. The major question areas were; instructional material, instructional equipment, student achievement, teaching methods, and reaction to the experimental research program. Questions were of a probing nature, asked in succession, and were not limited strictly to those in the guide, but rather only to the areas defined by the guide. The guide thus permitted pursuit of interesting remarks and reactions.

The questions were so arranged that the easily answered ones were first and the more provoking ones later. Each question area included an opportunity for the instructor to introduce any pertinent ideas, thoughts, and questions of his own. In this way, any oversights or biases in the guide were minimized.

Student Interview

The student interview was conducted using an interview guide to establish a semi-structured interview, and an orientation with the purposes:

1. To establish student motivation to insure the reliability and validity of their responses.
2. To eliminate any fear of personal reprisal that might restrict comments and answers.
3. To establish a common frame of reference for all classes.

Orientation. The orientation consisted of a summary

of information necessary to the attainment of the above objectives. Topics mentioned included operational definitions essential to the understanding of the questions, the purposes of the study, the possible effects of the study, the details of reporting the findings, the method used in the selection of samples, the scope of the study, and an opportunity to ask their own questions. The researcher's position, that student ideas were important, was also brought out. Both the orientation and guide are provided in appendix C.

Interview guide. The interview guide outlined questions in two main areas; teaching methods and instructional material, and the reaction to the experimental research program. The question items, based upon the selected aspects studied, involved details of teaching methods, the use of instructional material, student reactions to research activities such as observations and achievement testing, and student opinion of what should be. The latter section was of a free response nature. This allowed the students to make statements and volunteer any information about teachers, instructional material and other areas of concern to them. It was assumed that this section could provide information not easily available, if at all, through other means such as direct questioning. The validity and reliability of the interview would also tend to be increased by this means.

Achievement Measures

There was no distinct instrument used to describe or

evaluate the achievement measures employed by the Phase I research team, instead, the following procedure was used to provide the description and analysis of the achievement measures aspect of the experimental research program.

1. The minutes and reports of the research team were studied to obtain information describing:
    (a) The construction of the industrial arts achievement test (test is provided in appendix E).
    (b) The administration of the industrial arts achievement test.
    (c) The analysis of the results of the industrial arts achievement test.
2. Student, teacher, and test administrator comments were compiled and studied.
3. The above two sets of information were analyzed and the conclusions noted.

Description of Physical Facility

The physical facilities of the two experimental research laboratories were described using a device in the form of an outline. This device was developed from the guidelines advanced by J. D. Harder and A. A. Day, at that time Supervisor of Industrial Arts and Assistant Supervisor of Industrial Arts for Alberta, in a Department of Education publication entitled Industrial Arts Laboratory Planning (1968, p. 9-17).

The device consists of a listing of the Department

of Education guidelines, with a space opposite these for a description of the laboratory being described. The descriptions result from observations of the laboratory with respect to a particular guideline.

The final stage in the description of the physical facility was the preparation of a scale floor plan diagram representing each laboratory and the major items needed to make the description more meaningful.

Assessment of Physical Facility

The assessment of the physical facilities of the experimental research laboratories was made using the Evaluative Criteria for Junior High Schools (1963) developed in the USA by the NSSSE. The third part of the industrial arts section (P-8) was used. This section is a list of 38 items used to assess the basics, with respect to physical facilities, of laboratory and shop design, construction, and organization.

One item, number 15, was modified to increase its applicability to the method of laboratory organization employed in the experimental industrial arts research laboratories. The original item read;

> 15. School shop contains a convenient and centrally located tool and supply center, and where applicable, an adequate number of well-laid-out tool panel areas for special tools (NSSSE, 1963, p. 141).

The revised item reads;

> 15. School shop contains convenient area located tool and supply centers, and where applicable, an adequate

number of well-laid-out panels for machines requiring special tools.

Two items from the original list, numbers 26 and 27, were deleted because they pertained to questions that the experimental research program sought to answer, and due to the lack of documented conclusions and findings, any assessment of these two items would be merely speculative in nature. These modifications resulted in a checklist of 36 items.

Rating scale. The experimental research laboratory assessment proceeded by assigning a rating for each item in the list. This rating was an integral point on a five point rating scale that ranged from 0 to 4. The rating occurred immediately after the section of the assessment entitled "comments and explanations" corresponding to the NSSSE item was detailed.

The five point rating scale was numerical in nature, but also had explanations describing the conditions necessary for the assignment of a particular rating. In this way the reliability of the instrument was increased. The explanation of the conditions for the five ratings are as follows;

0 The NSSSE recommendation is completely absent in the experimental research laboratory

1 The NSSSE recommendation is only partially implemented in the experimental research laboratory, and this implementation is in an inadequate manner

2a The NSSSE recommendation is only partially implemented in the experimental research laboratory but the implementation is done in an excellent manner

Alternate condition.

2b The NSSSE recommendation is largely implemented in the experimental research laboratory but the implementation is in an inadequate manner

Alternate condition.

2c The NSSSE recommendation is moderately implemented in the experimental research laboratory and this implementation is in a moderate manner

3 The NSSSE recommendation is largely implemented in the experimental research laboratory and this implementation is in an adequate manner

4 The NSSSE recommendation is completely implemented in the experimental research laboratory, and this implementation is in an excellent manner

This method of assigning descriptions to each rating to increase the reliability of the instrument is patterned after the evaluation methods suggested in the Evaluative Criteria for Junior High Schools (NSSSE, 1963, p. 8).

Equipment Comparison

A device in the form of a checklist was used to compare the instructional equipment recommendations of the Department of Education with the equipment actually found in the two experimental research laboratories at the time of the study. The Alberta Industrial Arts Equipment List (1969) was used as the source of all the equipment recommendations with the exception of the graphic arts area. Since the 1969 Alberta Industrial Arts Equipment List does not include this area, the previous equipment list (May 1967 and supplement) was used to obtain the department's recommendations. In the case of alternate equipment choices, the

device listed the equipment corresponding to that found in the experimental research laboratory. If there was no corresponding equipment to be found the first item suggested was used in the device.

The checklist has 4 columns to indicate the equipment recommended by the Department of Education, the recommended quantity, whether the laboratory has this equipment, and any explanation and comments necessary to increase the usefullness of the comparison. The equipment comparisons are identified by the area and the school involved. Two major categories of equipment are identified within each area. These are, (1) hand tools and other small items, and (2) power tools, machines, and major equipment. In addition to these two categories, each area comparison has a section listing instructional equipment available in the experimental research laboratory, that is beyond the Department of Education's equipment list. A sample page of the equipment comparison is given in appendix F.

Classification of Instructional Material

The instructional material in the experimental research laboratories was classified by a table with cells indicating the quantity of any type and any category of material. As used here, the term types, refers to the varied methods or forms in which a piece of instructional material can be produced. In this study, the types considered are (1) sequential pictorial instruction (SPI) and programed

pictorial instruction (PPI), (2) films, (3) filmstrips, (4) audio-tapes, (5) slide-tapes, (6) television (TV) and video-tape (VT), (8) models, (9) research reports, (10) slides.

The categories of instructional material were developed on the basis of the objectives of the experimental industrial arts program, and the normal requirements of operating an industrial arts laboratory. The categories that were developed were also used in the student and instructor interviews. The categories developed deal with, (1) processes basic to industry, (2) machine and tool operation, (3) materials, (4) jobs and careers, (5) safety, (6) business, labor, unions, management, (7) principles of technology, (8) interrelating industrial arts to other courses, and (9) organizing the laboratory. These two factors, types and categories, formed a 10 x 9 matrix. As the instructional material was identified, it was classified by the particular combination of type and category it was.

Administration and Data Collection

Since the data was collected near the end of the school year, the following sequence, listed in the order of completion, was used: interviewing the student sample, interviewing instructors, describing the physical facilities, assessing the physical facilities, comparing equipment, categorizing instructional materials, and analyzing and describing the Phase I achievement measures.

This sequence of activities was necessary to gain access to information while the people best able to provide it were still within the school situation. The researcher administered all instruments and conducted all the interviews gathering data for this study. In all cases, the descriptive portion of an aspect was completed before the evaluative portions began.

<u>Administration of the Student Interview</u>

Once the required student sample was determined for each class, the instructor notified the selected students and then released them from the class into the researcher's care. The classes were interviewed according to the schedule given in table 2.

The researcher and each class sample conducted the interview in the King Edward library, and in an available free room in the case of Cartier McGee Junior High School.

Two unanticipated events required minor changes in the interview administration schedule. The interview for Parkallen 8B, originally scheduled the afternoon of the 22 of June, was missed due to an extended interview conducted earlier in the afternoon at Cartier McGee Junior High School. The interview with Parkallen 8B was subsequently rescheduled as indicated in table 2.

The delay leading to the missing of the Parkallen interview, was caused by an error in calling the selected sample of students for the afternoon interview at Cartier McGee.

Table 2

Student Interview Administration Schedule

Date	Morning	Afternoon
June 18	Garneau 8B	King Edward 8C
	Cartier McGee 9/4	
June 19	Garneau 8C	Parkallen 8A
June 22	King Edward 8A	Cartier McGee 9/1, 9/2, 9/3
June 23	Parkallen 8B	Garneau 8A
June 24	King Edward 8B	King Edward 9C

Instead of the selected samples being called in sequence as the interviews were complete, an error resulted in the samples from all three classes (9/1, 9/2, 9/3) arriving at the same time. Although this number of students (14) was considered to be large for the type of interview planned, it was not prohibitive, and it was accepted in view of the cooperative efforts of the school's principal, Mr. Bischof, and of the disruption a further change would cause.

The attempt was made to conduct the student interviews in an informal atmosphere with the researcher exerting only as much authority as was necessary to insure an informative interview. To expedite this process, the orientation was used in a brief discussion prior to the interview. This discussion combined with the orientation to serve as a motivating factor towards the valid and responsible answers. The discussion involved; the linking of the interview to possible improvements in the industrial arts programs, the position that student ideas are important, the idea that the responses are anonymous, and the opportunity to ask questions of their own.

Using a semi-structured approach, the interview was conducted by following the interview guide. The free response section, included near the end of the interview, allowed students to make statements and volunteer information about teachers, instructional material, and other areas of concern to themselves. This section of the interview was conducted using the drawing out method which is further

explained in the section of this study that describes the instructor interview.

The entire interview was tape-recorded to insure the amount of information available for analysis was at a maximum. Recording the interview also allowed the researcher to concentrate on obtaining information rather than dividing his attention by recording responses in addition to conducting the interview. References were consulted to determine the effect of tape-recording interviews, but few included any specific comments. One reference, written by John Rich, Interviewing Children and Adolescents (1968), however, specifically states,

> I completely disagree with people who state that a tape recorder necessarily inhibits a child (p. 85).
>
> Although tape recording does present difficulties, any means at our disposal to increase the value of interviews, either by improved technique or by improved assessment of what is said and done, is well worth the effort (p. 86).

Administration of the Instructor Interview

The instructor interview was scheduled at a convenient time mutually agreed upon by each instructor and the researcher. At the appointed time, the researcher discussed the proposal for the study, the orientation to the instructor interview, and any questions raised by the instructor. Each interview was conducted in a one to one setting, with only the researcher and the instructor present. To insure the availability of a maximum of information, each interview was recorded using a tape recorder.

Although conducted in an informal atmosphere, the use of the interview guide resulted in a semi-structured interview as planned. Mr. R. Wilkes was interviewed Friday, June 26, Mr. R. Hendricks, Tuesday, June 30.

The questions in the interview were asked using the conference technique for drawing out information. This technique is described in The Conference Method (Ziel). There are two essential steps to the drawing out, that are applicable to this study:

1. Phrase questions clearly and concisely.
2. Construct questions which will require participants to draw on their experience (p. 9-1, 9-2).

With respect to tone and manner in asking the questions of both student and instructor interviews, the ideas advanced by Ziel were considered and adopted. Ziel states,

> The tone and manner used in asking the question are just as important as the words used. A leader can make a good question produce a poor reaction by failing in this respect. He must above all display a real interest in the subject and in the answer. He must convey the idea that he really wants to hear the views of the group. He asks the question, and in so doing he obligates himself to listen carefully. If he displays indifference, sarcasm, or a know-it-all attitude he will discourage the participants from expressing themselves fully . . . (Ziel, Conference Leadership, p. 9-2).

The researcher made every attempt to incorporate the suggestions of the above quotation into the interviews. Also included was the knowledge that the method of acknowledging responses is important in drawing out further responses. A summary of Ziel's position with regards to acknowledgement,

which was also the position adopted by the researcher, would be to stay neutral but interested (Ziel, Conference Leadership, p. 10-1).

Administration of the Outline for the Description of the Physical Facility

The administration of the description of physical facility outline was conducted by the researcher while in the experimental research laboratory being described. The observable conditions corresponding to the Department of Education's recommendations, were described in the same sequence as these recommendations. In any cases of doubt or question of the accuracy of the observations made by the researcher, the instructor was consulted and the combined observation noted.

Administration of the Checklist for the Assessment of the Physical Facility

The researcher completed the assessment of the physical facilities of the experimental research laboratories while in the laboratory being evaluated, but only after the laboratory had been described. Each NSSSE recommendation was applied to the experimental research laboratory and considered with the rating descriptions in mind. Both the degree of implementation and the quality of implementation were judged as required by the rating descriptions. The comments and explanations column explains the rating. The procedure followed involved first the noting of the comments and explanations, and then the rating.

Administration of the Equipment Comparison Device

The researcher completed each area's equipment comparison while in that particular area, but only after each laboratory was rated. Observations were noted, and any explanations needed to support the comparisons were given. The instructor was consulted in cases of difficulty in determining the inventory of smaller tools which might not be found easily, and thus overlooked. The instructor was also consulted when an item recommended by the Department of Education was not found. The last step in the equipment comparison involved the listing of major equipment present in the experimental research laboratories, but not included in the Alberta Industrial Arts Equipment List (Department of Education, 1969).

Administration of the Classification of Instructional Material

Each laboratory was surveyed by the researcher to determine the instructional material available. The emphasis of effort centered upon printed materials when it became obvious that this form was most prevalent. As materials were identified, they were placed in the classification system of types and categories according to their content and media. The overall quantity of materials available in each category will provide an indication of the emphasis or lack of emphasis of the experimental industrial arts program.

Administration of the Criteria to the Achievement Measures

There was no instrument administered, instead data

were collected by studying the research reports and minutes of the meetings of the research staff. A study of the documentation, that which was available, indicating the comments of students, instructors, and test administrators regarding the achievement tests was also performed. A summary was prepared of the Phase I achievement testing program, and this summary became the basic material analyzed. This summary is presented in chapter 4, in the section describing the sample used for achievement measures.

Chapter 4

Analysis of Data

Introduction to Data Analysis

The methods of data analysis that were applied to the results of the various instruments are listed below. The methods are listed in the chronological sequence of the application of the instruments.

Interviews

For the student and instructor interviews, a content analysis technique was used to tally and classify the responses and ideas. The code used to determine and develop the classification is based upon a preliminary analysis of the interview.

Physical Facilities

After the description of the physical facilities was prepared, they were analyzed using the NSSSE checklist and a summated rating scale. Overall assessment was reported in percentages of the maximum attainable score.

Instructional Equipment Comparison

The instructional equipment was compared to a list of recommended equipment. Assessment was done in three categories of equipment and was in terms of the congruence between the recommendations and the findings.

Instructional Material

Instructional material was classified by type and category, and the overall assessment was made on the basis of the quantity of material available in each cell.

Achievement Measures

The achievement measures used by the Phase I research team were analyzed by applying the basic criteria of testing.

Population and Sample Data

The population for this study was composed of the students, industrial arts laboratories, and instructors in the King Edward and Cartier McGee Junior High Schools. More specifically, all eighth and ninth grade students in the King Edward industrial arts classes taught by Mr. R. Wilkes formed part of the student population. In the case of Cartier McGee school, only the students from 9/1, 9/2, 9/3, 9/4, all classes taught by Mr. R. Hendricks, were involved in the study.

The King Edward laboratory was equipped for the first phase (Phase I) of the program advocated by the industrial arts rationale. On the other hand, the Cartier McGee laboratory is equipped for both Phase I and Phase II. Because of the agreement between the Department of Industrial and Vocational Education of the University of Alberta and the Edmonton Separate School Board, the responsible local authority for Cartier McGee School, only the Phase II portion of the laboratory is involved with the experimental research

program. It is for this reason that only the grade nine classes formed a part of the population for the study. They were the only Cartier McGee students exposed to the Phase II aspect of the experimental industrial arts program.

It was these laboratories, within the parameters mentioned, their students, instructors, and equipment that formed the population for the study. The classes and their enrollments at the start and end of the 1969-1970 school year are given in table 3.

Method and Analysis

Interviews--Content Analysis

Method. Both the student and the instructor interviews were analyzed using the method of content analysis. A definition for this process is given by Fox in his book, The Research Process in Education (1969):

> Content analysis . . . a procedure for the categorization of verbal or behavioral data, for purposes of classification, summarization, and tabulation (p. 646).

The study used content analysis only at the manifest level, with a very minimum of classification occurring on the basis of latent level data. The reason for this distinction is best given by Fox (1969), who states:

> There is ample evidence to indicate that content analysis at the manifest level can be accomplished reliably and validly but this can not be said of content analysis at the latent level (p. 648)

Support for the use of the content analysis technique came from Borg, author of Educational Research: An Introduction

Table 3

Industrial Arts Class Enrollments, 1969-1970

School	Class	Enrollments September	Enrollments June
Garneau	8A	9	11
	8B	15	16
	8C	16	16
King Edward	8A	5	8
	8B	9	11
	8C	13	12
	9C	15	16
Parkallen	8A	19	20
	8B	19	16
Total Phase I		120	125
Cartier McGee	9/1	16	11
	9/2	16	12
	9/3	18	12
	9/4	18	12
Total Phase II		68	47
Total Phase I & II		188	172

(1963)

> The content analysis technique is very well suited for small scale educational research projects, and it is surprising that more students do not carry out content analysis studies (p. 269).

In order to obtain satisfactory reliability when using this technique, Fox states, "a pilot study is a critical must" (1969, p. 648). The purpose of the pilot study is to develop a code or system for classifying the communication, in this case the interview. This was done in the study by using all the interviews first for generating a suitable classification system for their content. In addition to these interviews, the interview guides were also used to assist in generating additional items for the code. The code thus developed was then used to classify the interview content as each was listened to again. Tables 5 to 14 were prepared and they indicate the content of all of the interviews classified according to the developed code.

<u>Sample</u>. The samples indicated in table 4 represent a selection of random numbers selected from tables described in the section entitled "Procedures." These selected students then were interviewed as groups. If a selected student was absent, the next higher or lower student was selected. Should either not have been available the closest student to the selected one's position was used. Forty two students from the King Edward industrial arts classes were interviewed. This amounts to 35% interviewed. Seventeen students from the Phase II industrial arts classes were interviewed. This

Table 4

Random Samples for Student Selection for Interview

Class Size	Sample Size	Selected Random Numbers
20	7	10, 8, 12, 11, 9, 15, 4
18	6	7, 10, 12, 14, 8, 5
16	5	12, 11, 15, 4, 8
14	5	4, 13, 5, 14, 7
12	4	6, 4, 5, 9
10	3	1, 6, 4
8	3	8, 4, 5
6	2	5, 3

amounts to 25% actually interviewed. Both of these calculations, 35% and 25% are based upon enrollment data obtained at the start of the year 1969-1970. When using enrollment data from June 1970, the total student sample from both schools amounts to 34%.

Instructor sample. All or 100% of the instructors involved with the experimental research program were interviewed. These instructors were Mr. R. Wilkes and Mr. R. Hendricks of King Edward and Cartier McGee schools respectively.

Analysis-student interview. The content analysis of the student interviews is given in tables 5 to 8. The code developed for this analysis primarily followed the sequence of the interview guide. Table 5 results from the analysis of student responses to questions pertaining to instructional material. Table 6 and table 7 provide indications of student reactions to the experimental research program. Table 8 consists of the analysis of the free response section of the interview. Here some of the student's perceptions, desires, and opinions are voiced.

Analysis-instructor interview. The content analysis of the instructor interviews is given by tables 9 to 14. As in the student interview analysis, the code developed for the classification generally follows the sequence of the instructor interview guide. Table 9 and 10 provide the

Table 5

Student Interview Responses

<u>Questions 1-12</u>

Abbreviation code: A-T--audio-tape, F--film, FS--filmstrip, M--model, PM--printed material, RR--research report, S--slide, SPI--sequenced pictorial instruction, TV--television, OS--other students, ID--instructor demonstrations, IL--instructor lectures, T--tours.

Question	Response													
	A-T	F	FS	M	PM	RR	S	SPI	S-T	TV	OS	ID	IL	T
Which type(s) of instructional material did you use to learn:														
1. Machine and tool operation?		13	1	1	14			14			1	15	2	
2. Processes basic to industry?		2			4							4	2	
3. Jobs, careers, and requirements and working conditions?		3			1	1							5	
4. Safety and safe operating procedures?		4			11						2	10	10	
5. Materials, properties and characteristics?		5			5	1						2	9	
6. Organize the laboratory?													12	
7. Labor, management, unions, industry?	1	3	1	1	2								2	
8. Basic principles of technology?	1	1	1	1	4								1	

Table 5 (Continued)

Question	Response													
	A-T	F	FS	M	PM	RR	S	SPI	S-T	TV	OS	ID	IL	T
9. Interrelate industrial arts areas, and industrial arts with other courses?													6	
10. Which type(s) of instructional material did you or would you enjoy most?		10	4	1	1		1	7	10	5	1	12	2	2
11. Which type(s) of instructional material was most effective for learning?		6	2	6	4	3		5	2	3	1	11	2	1
12. Which type(s) of instructional material would you like to see used more often?	1	9		1				2	7	3		3		1

Table 6

Student Interview Responses

Questions 13-17

Question	Response: Yes	Response: No
13. Did you know you were a part of the experimental research program?	12	5
14. Did your instructor ever discuss the experimental research program with you or with the class?	3	5
15. Were you bothered by the presence of the researchers during the year? Did they interfere with your work?	4	14
16. Did you begrudge the time the researchers required of you for research activities such as tests, discussions and interviews?	6	6
17. Do you feel that students have ideas that can contribute to industrial arts research?	11	0

Table 7

Student Interview Responses

Questions 18-20

18. How did you know, how were you told, that you were a part of the experimental research program?

Response	Frequency
The teacher told me/us	7
The researcher told us at the time of the pre-test	6
The researcher told us at some other time	2

19. What did your instructor say about the experimental research program?

Response	Frequency
The University of Alberta paid for the equipment	12
The University of Alberta has a research program	2

20. How would you change the experimental research program as you know it?

Response	Frequency
Shorter tests	1
Fewer tests	3
Combine research tests with class tests	1
Give research exams at other time (class)	1

Table 7 (continued)

Response	Frequency
Do not have researchers talk superior to students	2
Have researchers just observe	1
Do not have researchers interfere with student projects and activities	4
Have the researchers assist the teacher as another teacher	1
Have a permanently assigned researcher to the school, don't change them	1
Maintain a steady program, don't change during the year	1

Table 8

Student Interview Responses

Questions 21-26

If you could change things, what would you like to see happen in the industrial arts course, what kinds of things are good that you would like to see more of, and what kinds of things are not so good that you would like to see less of? What should be changed with respect to:

21. the instructor?

Response	Frequency
He should give more individual attention	9
He should be more enthusiastic	1
He should teach students to teach others	1
We need another teacher in addition to ours. This will eliminate waiting	14
He should teach more about hand tools	1
He should change students to individual rotation	1
He should lengthen class time	1
He should exert more discipline	2
Intercom system should be used	2
He should give more demonstrations	1

22. the physical facilities?

Response	Frequency
A bigger laboratory with a garage door for a car	2
Better ventilation in laboratory	8
More sinks to wash up	4
The laboratory should be cooler	2

Table 8 (continued)

Response	Frequency
The laboratory should be organized to eliminate self-contained areas	1
The laboratory should be bigger	5
There should not be so much dust in the air	5
The clean-up should be better	2
The laboratory should be painted	2
Student lockers should be provided	1

23. the instructional equipment?

Response	Frequency
Provide more in all areas	1
Provide more in power mechanics	1
Provide more drills and sanders	1
Provide more vises	1
Provide more molds in plastics and ceramics	1
Provide welders in power and metals	2
Provide a real car to work on	1
Provide a power hacksaw	1
Provide another wheel in ceramics	1
Provide another metal lathe	1
Provide a movie camera	1
Provide new faceshields	1
Establish a leather area	2
Establish a drafting and planning area	3
Establish a hot metals area	1
Include glass area in ceramics	1
Introduce electricity and power-mechanics	1
Eliminate the hydraulics section	1
Eliminate the electricity, electronics area	1

Table 8 (continued)

Response	Frequency
Eliminate the graphic arts area	1
Eliminate the ceramics area	5
The laboratory is equiped ok	1
Some equipment is too elaborate and fragile	2
The jigsaw needs to be mounted to the floor	1
Use of the radial arm saw and of the offset press should be allowed	1

24. books and printed materials?

Response	Frequency
The electronic books are hard to understand	1
There are lots of books available	13
Generally, books are hard to understand	2
Books don't apply to what we are making	4
Books are not used often	5

25. other instructional materials?

Response	Frequency
Much more instructional material could be used	9
There is lots available	1
More PPI's and SPI's should be used	4
More films should be used	2
There should be a greater variety of instructional material	2
The tape-system should be used	3
There should be more models used	2

Table 8 (continued)

26. products?

Response	Frequency
We should be allowed to make what we want	1
We should design our own products	18
We should make more products	13
There should be less experiments	2
The products should be less rigid	2
We should work on real equipment (power)	1
Troubleshooting should be introduced	1
More materials and supplies should be kept on hand	12
There should be more interesting products	5
There should be electrical products	3
There should be more time to work on products	2

Table 9

Instructor Interview Responses

Questions 1-10

Abbreviation code: M--materials, P--processes, J--jobs and careers, MO--machine operation, S--safety, B--business and labor, PT--principles of technology, O--organizing laboratory, I--interrelating industrial arts, 1--one instructor, 2--both instructors

Question	Response									
	Yes	No	M	P	J	MO	S	B	PT	I	O
Did you use:											
1. SPI's	2			1		2					
2. Slides		2									
3. TV		2									
4. Films	2			2	1	1			1		
5. Models	2			2		1			1		
6. Printed Matter	1	1	1	1	1	1					
7. R. Reports	2		1	1							
8. Filmstrips	1	1				1					
9. Audio-tapes	1	1							1		
10. Slide-tapes		2									

analysis of instructor responses to the various questions pertaining to instructional material. Table 10 is especially interesting, for it provides data about the instructor's perceptions of the advantages and disadvantages of various instructional materials. Table 11 provides much the same information except for instructional equipment in this case, Table 12 shows the result of the content analysis indicating the instructors use of teaching methods. Table 13 results from the analysis of the instructor's responses to questions concerning achievement measures they employed. Table 14 perhaps provides the most useful insights into the experimental research program. This table results from the content analysis of instructor reaction to the experimental research program.

Physical Facilities--Description and Assessment

Method. The method of analysis used in the assessment of the physical facilities involved the use of a summated rating scale. The overall rating indicates the congruence of the laboratory concerned with the recommendations developed by the National Study of Secondary School Evaluation. Because the recommendations dealt with such commonalities such as lighting and safety factors, the content validity was taken to be high to begin with, and even higher with the modifications explained in the instrumentation section of this study. Further support for this instrument's content validity is its close similarity to the Department of Education guidelines

Table 10

Instructor Interview Responses

<u>Questions 11, 12</u>

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11. Did you use any other type of instructional materials not mentioned here? If so, specify, and for which type(s) of student activity?

    <u>Response</u>. Wall charts. They eliminate much reading. Used for instructing about processes, tool and machine operation, jobs and careers.

    <u>Response</u>. Models. Have students make own models to be left in the laboratory. This substitutes for research reports.

12. Based upon your experience in the past two years, what are your findings about the uses, effectivieness, disadvantages, and problems of each of the above mentioned instructional materials?

    <u>Responses</u>.

    SPI's — Must be good. Difficult to make. Student understanding is difficult to estimate. Students don't want to read. Students associate an SPI with a book, thus they are not always used.

    Slides — Facilities for making them are needed. They afford edit possibilities. They require a projector and screen.

    TV — Scheduled programs present a problem because all classes can't be released to watch it at any given time. Video equipment is rare and expensive. Little time is available to set up and prepare programs. Student operators are an asset.

    Films — The students have the idea that films are for enjoyment, not learning. They are excellent for process not possible in the laboratory. Best for enrichment. It is difficult to get a film for what you want.

    Models — Provide a standard for comparison. Point out processes.

Table 10 (continued)

Printed materials	Not many students make good use of books. Students do not want to read, they rather ask instructor. Books are used for reference.
Research reports	Concentrate effort on an idea or topic. They are difficult to read and mark because of the poor composition and writing. Should be combined with english and language arts assignments. Time-consuming for both teacher and student.
Film-strips	They are useless because of the inability to edit. They require a lot of time to prepare. IA is not at the stage where the preparation time is justified.
Audio-tapes	Are time-consuming to prepare. Require the availability of several recorders. Once made, they form the core for several presentations.
Slide-tapes	Work well once produced. Can also use overhead transparencies. Are time consuming to make.
Wall charts	Work better than SPI's. They eliminate reading to a degree. They eliminate the dirt and handling problem. They are always ready for reference.
Tours	They are expensive and time-consuming. Not all industrial plants are accessible because of policy and insurance.

Table 11

Instructor Interview Responses

Questions 13-18

Areas	Question					
	Q. 13 Most Eff.	Q. 14 Least Eff.	Q. 15 Added To Area	Q. 16 Removed From Area	Q. 17 Modified	How
Woods	Lathe	Dia-press	none	Dia-press	Band Saw	?
Metals	Lathe Mill Shaper	none	Surface grinder Hyd. press Spot welder	none	Shear Brake	Bigger Bigger
Plastics	Injec. press	Roto-molder	Extru. press Strip bender	none	Perry former Roto-molder Hona-jector	To ease blow forming Window, better seals Stronger, larger hopper

Table 11 (continued)

Areas	Question					
	Q. 13 Most	Q. 14 Least	Q. 15 Added	Q. 16 Removed	Q. 17 Modified	How
Graphic Arts	Offset press Sign press	none	none	Book binding	Offset	Made simpler to show more
Ceramics	Jig & wheel	none	Cement molds Enamel kiln	none	Wheel	Better knee switch
Materials Testing			Not taught			
Electricity			Not taught			
Graphic Communications	Plate maker	Enlarger	Equip. for micro & printed circuit boards	none	none	

Table 11 (continued)

Areas	Question					
	Q. 13 Most	Q. 14 Least	Q. 15 Added	Q. 16 Removed	Q. 17 Modified	How
Electronics	Oscil-iscope	Circuit kits	none	none	undecided	
	PDP-8	EKS boards				
Power	none	Go-power test stands	Other sources than heat engines	none	Go-power	Up-graded

Question 18

What other comments have you about the equipment in the laboratory that you have not yet mentioned?

Response. The necessary handtools for the power mechanics and electronics area are not available.

Table 12

Instructor Interview Responses

Questions 19-21

Q. 19 Teaching Method	Activities								
	MO	S	J	M	B	I	O	PT	P
Lecture--class		2		1		1	1		
--group		1						1	1
Demonstration--class	1			1					
--group	2	1							1
--ind.	1	1							1
Field trips									
A-V presentations									1
Programed Presentations									
Independent study			1	1				1	

Abbreviation code:

MO--machine operation, S--safety procedures, J--jobs, careers, M--materials, B--business, unions, I--interrelating industrial arts, O--laboratory organization, PT--principles of technology, P--processes

Table 12 (continued)

Q. 20 Did the laboratory arrangement determine the teaching methods used?

<u>Response</u>. No

<u>Response</u>. Yes, there were few lectures to class because of a lack of a lecture area where the class could sit down.

Q. 21 Did the instructional equipment determine the teaching methods used?

<u>Response</u>. Yes, all equipment does. Dangerous equipment required individual demonstrations.

<u>Response</u>. Yes. If equipment was not operational alternate methods of instruction had to be devised.

Table 13

Instructor Interview Responses

Questions 22-26

Q. 22 What system did you use to determine a student's overall standing for report marks?

Response. Used report cards. This mark was composed of product marks, little written work, observations of how well students worked, how well they cooperate, the amount of direction needed. Products composed approximately 40% and attitude and behavior 60%.

Response. Used a flow sheet at first. Then changed to a status card system. This involves a number of scores on different scales. Scales include products, worksheets, violations, attitudes, executive positions, safety.

Q. 23 What methods did you use to assess the gross knowledge of facts, details, and procedures?

Response. Questions during class and observation.

Response. Questions during class and quizzes for some things.

Q. 24 How did you assess the student's understanding of ideas, concepts, and principles?

Response. Using questions that incorporate problems to make students think. Asking for comparisons between industrial and laboratory methods.

Response. I don't know, how do you assess this?

Q. 25 How did you evaluate student products and/or experiments?

Response. This is difficult. Use letter grades. It is rather subjective.

Response. By judging quality, accuracy, correctness in the case of an experiment. A quiz is sometimes used afterward.

Table 13 (continued)

Q. 26 Were there any other evaluative techniques and methods used but not already mentioned? What were they?

<u>Response</u>. Observation was used often.

<u>Response</u>. Observations were used. Written safety tests were also used. Critical incident technique was attempted but not successfully. The assessment of the executive positions depended upon observations of the student's ability to direct and cooperate with other students.

Table 14

Instructor Interview Responses

<u>Questions 27-38</u>

Q. 27 How did you become aware of the University of Alberta's Department of Industrial and Vocational Education's experimental research program?

<u>Response</u>. On September 1, 1968 they (office staff) said to telephone the industrial arts supervisor for the system. I was then told I had a choice between the experimental research program and an opportunity class at another school.

<u>Response</u>. The principal received a letter about it. He subsequently told me that this school had been chosen for the experimental research program.

Q. 28 How did you become one of the instructors in the experimental research program?

<u>Response</u>. As indicated before. (Q. 27)

<u>Response</u>. That was arranged by the school board and the University of Alberta. There was no individual contact until after the fact.

Q. 29 Who do you feel was instrumental in establishing the experimental research program in the Edmonton school systems?

<u>Response</u>. No one person in the school board. Mr. Gallagher seemed to be calling all the shots, but I'm not sure.

<u>Response</u>. I don't know. Maybe J. Gallagher, but my greatest contact was with Dr. Sullivan.

Q. 30 With respect to the experimental research program, what commitments were made to you:

a. by the Department of Industrial and Vocational Education? Who? When?

b. by the school board? Who? When?

c. by your school administration? Who? When?

Table 14 (continued)

Q. 30 Continued

<u>Response</u>. None were made between the U of A and the teacher. The teacher was incidental. No commitments were made to the teacher at all. He was left out entirely. He did see the commitments later in a letter.

<u>Response</u>. The commitments were contained in a letter (summarized in appendix A). These were between the university and the school system. There were no commitments between the teacher and the school board or the school administration.

Q. 31 Were these commitments kept? If not, which were not kept? Do you know (or guess) why not?

<u>Response</u>. Many were not kept. I feel that this was because the program was mis-directed, a mis-administrated effort. Somebody thought it was a good idea and the thing started rolling with little regulation.

The instituting of new programs was not done. Little curriculum material was given to me.

Q. 32 How was the experimental research program implemented at your school?

<u>Response</u>. As indicated before. (Q. 27)

<u>Response</u>. Two students from the university came and set up the equipment. J. Gallagher came out and said what was planned.

Q. 33 During the experimental research program, did the investigators from the university by watching, working, and discussing problems, interfere with your instructing of the course? If so, how?

<u>Response</u>. No. Not too many even came out.

<u>Response</u>. No.

Q. 34 What do you feel are the most useful outcomes of the experimental research program?

<u>Response</u>. We have had one of the best equipped shops

Table 14 (continued)

Q. 34 Continued

in the city and consequently, the students have had a good program. It made the course more interesting. The equipment was upgraded tremendously from its condition in 1968. The school board paid for this.

<u>Response</u>. I can't think of anything other than knowing and demanding of future research programs that they be laid out clearly and succinctly as to what is going to be and who is going to direct and organize the program.

Q. 35 What do you feel are the least useful aspects of the experimental research program?

<u>Response</u>. I don't see what the university has benefitted from it. It was two years of disorganized state.

<u>Response</u>. Teachers get little information of what is going on. It was two years of a disorganized state. By stalling and waiting for curriculum material, the program was damaged. The changing of directors resulted in a need for orientation.

Q. 36 With respect to the experimental research program, what would you have changed or done in another manner, using the past two years as a guide?

<u>Response</u>. If it were sprung like this again, I would refuse classes until things were organized.

There should be firm commitments by all parties about what is to go on.

The university has benefitted little. I have seen few guys here. The program should be planned better in the first place.

<u>Response</u>. Layout the program at least a year ahead of time.

Define the behavioral objectives.

Run the program as it was planned.

Analyze the results.

Table 14 (continued)

Q. 36 Continued

There should be someone from the university (other than a Graduate Teaching Assistant or Graduate Service Assistant) spending at least 50% of his time in the laboratory. This will allow proper planning and administration.

Q. 37 How do you feel about the experimental research program being discontinued in its present form?

<u>Response</u>. As far as I can see, it was more or less non-existant right from the beginning. I won't notice much difference.

It didn't start properly, but there should be a place where they can try out new ideas.

<u>Response</u>. I am in agreement with this until the program is organized.

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used for the outline of the physical description of the laboratories.

The rating of each laboratory is reported in percentages of the total possible rating. While the implied accuracy of percentages is probably not justified (not to the nearest percent) the figures never-the-less provide a good objective indicator of the laboratories' state with respect to physical facilities.

Sample. The Phase I laboratory at the King Edward Junior High School and the Phase II section of the industrial arts laboratory at Cartier McGee Junior High school, formed the sample and population for this aspect of the study. The immediate surroundings of these laboratories were also considered as required by certain criteria used in the descriptive and evaluative instruments. The best description of the sample is given by the outline device (tables 15 and 16) based on the guidelines set by the Department of Education.

Assessment of physical facilities. The entire assessment of physical facilities was conducted using the NSSSE checklist and a rating scale. In this way the effect of opinions and biases was minimized. The rating was not performed with an absolute reference, but rather with specific reference to the NSSSE item alone. The assessment is provided in two sections, one pertaining to each of the experimental research laboratories, table 17 pertains to King Edward JHS

Table 15

Description of Physical Facility-King Edward JHS
Experimental Research Laboratory

Dept. of Ed. Recommendations	Comments - Description
1. Proportions and shape; Rectangular, this is the most commonly used shape and has many benefits which range from economy of construction to efficient interior layout. Proportions of 1:1 1/3 (1:1.33) to 1:1 1/2 (1:1.5) are recommended.	The laboratory is rectangular in shape. Its proportions are 31/72 or approximately 1:2.32. It is longer and narrower than recommended.
2. The recommended area allotted for each student might be 150 sq. ft. for junior high . . . where only one laboratory is provided. This would include auxiliary space for storage, conference room, wash area, office and darkroom.	The total area is 2304 sq. ft. Taking a class size of 20, the laboratory is only 115 sq. ft. per pupil. Thus it is sufficient for about 15 pupils as judged by the recommendations.
Area allotments: subject to other considerations, the areas in square feet recommended for the various units and services in a multiple activity laboratory are given below.	
Electricity-electronics 200 sq. ft.	Not applicable.
Power mechanics 300 sq. ft.	Not applicable.
Graphic communications 400 sq. ft.	Not applicable.
Photography 100 sq. ft.	Not applicable.
Wood 350 sq. ft.	Is 264 sq. ft. about 3/4 of the recommended area.

Table 15 (continued)

Dept. of Ed. Recommendations	Comments--Description
Graphic arts 150 sq. ft.	Is 300 sq. ft., about twice the recommended area.
Metals, machine--sheet 360 sq. ft.	Is 336 sq. ft., about 11/12 of the recommended area.
Plastics 150 sq. ft.	Is 157 sq. ft., and is approximately the recommended size.
Ceramics 150 sq. ft.	Is 195 sq. ft., about 1 1/3 as large as recommended.
Materials testing 100 sq. ft.	Not yet set up, but the recommended area is available.
Storage 240 sq. ft.	Is 88 sq. ft., about 1/3 of the recommended area.
Offices 80 sq. ft.	Is 72 sq. ft., about 9/10 of the recommended area.
4a. Laboratory site: the site should be large enough for future expansion of the building.	Expansion is possible. The laboratory is in the basement of a wing in the school. Adjacent space is available.
4b. Each laboratory should have independent access from the main building, especially for students that are bussed in and for night classes.	Access is available both through the school and from the outside.
4c. Laboratories should be above ground level.	The laboratory is below the ground level. It is in the school basement.
4d. Laboratories should be accessible from a service drive.	Service drive access is available, but entrance of large items is difficult because of stair well.
5a. Laboratory plan: Laboratory areas for industrial arts should be planned for flexibility as to allow for	Flexibility is somewhat hindered by the wall registers as shown in the floor plan, figure 7.

Table 15 (continued)

Dept. of Ed. Recommendations	Comments--Descriptions
5a. Continued the rearrangement of furniture and equipment.	
5b. Partion walls should be kept to a minimum	Only necessary ones around around the office and storeroom are built.
5c. Partions should be non-bearing and free of ducts, internal conduits and pipes.	This is the case.
5d. All parts of the laboratory should have visual access from the main activity area.	This is the case.
5e. Utilities should be placed on the perimeter walls where possible.	This is the case for electricity, air, gas, and water.
5f. Provision should be made for these services to be moved or extended.	This is the case except for a water drain.
5g. Provision must be made for the removal of exhaust fumes where such are generated.	A non-powered ventilation hood is in the metals area.
5h. Provision should be made for dust removal by either a built-in system, or by collectors placed on the machines.	There is no dust removal system, nor are there collectors on the machines.
5i. Technologies or material areas that are closely related should be placed in close proximity to each other.	This is the case as much as possible.
5j. Provisions for a clock should be made.	A clock is provided and it is easily seen from the main activity area.

Table 15 (continued)

Dept. of Ed. Recommendations	Comments--Description
5k. Spacing between benches and machines and other equipment should be sufficient for student's safety and free passage.	This is generally the case. The arrangement and orientation of the equipment does not follow the recommendations of manufacturers.
5l. Safety zones should be clearly marked.	There are no safety zones in the laboratory.
<u>Structural considerations</u>	
6a. Walls, masonry construction, painted or plywood at least to 48" from the floor.	The walls are concrete block, painted. They are quite dirty.
6b. Suitable sound absorbing material from there to the ceiling.	There is no sound absorbing material on the walls.
6c. Ceiling, height should be a minimum of 10' to the underside of beam, and covered with sound deadening insulation.	This is the case.
6d. Doors, proper exit doors as required by the fire regulations must be installed.	Yes, three entrances/exits are provided, but the outside exit requires steps to reach it. These are not present.
6e. Coloring, a pleasing color scheme should be planned. Light colors are preferred.	The laboratory is generally painted in light colors, but it is dirty and chipped.
6f. Floors should be pleasing in appearance.	Wood floor is worn, but is varnished each year.
6g. Floor materials by areas	
Electronics tile, wood	Not applicable.
Power mechanics painted concrete	Not applicable.

Table 15 (continued)

Dept. of Ed. Recommendations	Comments--Description
Graphic communications tile, wood	Not applicable.
Photography tile, wood	Not applicable.
Graphic arts tile, wood	Wood, well worn.
Woods tile, wood	Wood, well worn.
Metals concrete	Wood, well worn. There is also an 8'x8' square of concrete floor under the fume hood.
Plastics tile, wood	Wood, well worn.
Ceramics concrete with drain	Wood, well worn, no floor drain is provided.
Materials testing tile, wood, concrete	The space available for this area has a wood floor.
Materials storage concrete	Concrete.
Office tile	Wood, well worn.
6h. A coat rack should be provided either in the corridor next to the laboratory or near the entrance to the laboratory.	Coat rack and shelf is provided just inside laboratory entrance as shown on the floor plan.
6i. An attractive display case should be built into the wall near the laboratory entrance and face the corridor.	No display case is so provided. Other display cases throughout the school may be shared.
6j. Moveable chalk and bulletin boards should be provided in strategic locations.	A moveable and one unmoveable tackboard is in the laboratory, but access is difficult because of high mounting.

Table 15 (continued)

Dept. of Ed. Recommendations	Comments--Description
6j. Continued	
	There is a large fixed blackboard across the front of the laboratory.
6k. Adequate storage needs to be provided for materials and student lockers.	Some material storage area is available in the storeroom as well as in drawers and cabinets under the benches. There are no student lockers, but there are some class lockers.
6l. Keyed class or student lockers are recommended.	Class lockers are keyed but they are small.
Special recommendations	
7a. Heating units should be of low noise level and of slow air movement type.	Generally yes, but there are two registers that protrude into the laboratory and blow a fast stream of air that circulates any dust.
7b. Registers should be accessible for cleaning.	Because the registers protrude into the laboratory they sometimes get blocked by equipment placed in front of them.
7c. Closed areas such as the darkroom and the conference room should be adequately heated and ventilated.	The storeroom is the only enclosed area and it is not ventilated.
7d. Lighting should be adequate and safe. Artificial lighting should be provided at the intensity necessary for the activity.	Fluorescent lighting is used.
General lighting 50 candle power	The general reading at bench level ranges from 10 to 36 ft. candles.

Table 15 (continued)

Dept. of Ed. Recommendations	Comments--Description
Machines individual lights	There are no individual lights on the machines.
Darkroom safelights	Not applicable.
Electronics incandescent lamps	Not applicable.
7e. At least one keyed master control switch to control all outlets except the lights, should be installed with at least one auxiliary panic button strategically placed.	Such a switch and button are installed except the switch is not keyed.
7f. Electrical outlets should be provided on every unbroken wall space of four feet or more at intervals of six to eight feet.	This is the case in the areas. Perimeter conduit is provided.
7g. Special wiring of 220 volts must be provided in areas as follows: woods, plastics, ceramics, materials testing.	220 volts are provided in ceramics and wood areas, but not in plastics and materials testing areas.
7h. Floor outlets need to be provided for certain machines that must be placed away from the wall such as the circular saw. These outlets should be recessed and flush with the floor.	Two floor outlets are provided, but more could be used. One is a turtle back outlet and can be tripped over.
7i. Adequate washing facilities should be provided in each laboratory.	There is no wash-up sink provided. There is a sink in the ceramics area that has been used for this purpose, but it is small.
7j. Each laboratory should be provided with a drinking fountain.	There is none in the laboratory.
7k. Use a regular developing sink in the darkroom.	Not applicable

Table 15 (continued)

Dept. of Ed. Recommendations	Comments--Description
7l. Cupboards with sinks built in need to be permanently installed.	The ceramics sink is so installed, but the water drain and supply to the plastics area is not.
7m. As much of the furniture work-tables, tool boards, etc., as possible, should be portable.	This is the case.
7n. Table tops in all areas are recommended to be 30" wide.	Most of the tops are 25" wide. Most are a type of laminate top.
7o. A desk is required in the teacher's office.	This is available, as is a well designed storage center.
7p. Equipment should be placed so that it can be safely operated. Safety zones around each machine should be designated on the floor by painted lines or tape.	The equipment is generally well placed for a multiple activity laboratory. The guidelines developed by the Rockwell company have not been followed with respect to machine orientation to light. Some positioning suggestions have not been followed.
7q. Equipment, except that which is portable, should be fastened securely to a bench or other stable foundation.	All the machines requiring mounting are mounted except for the jig-saw.
7r. Equipment should be placed at a comfortable working height for the students.	Working height is satisfactory for average students.
7s. Machines that create vibration should be cushioned with shock absorbing material and in most cases be placed on individual tables.	This is the case except for wood lathes.

Fig. 7

King Edward Junior High School

Experimental Research Laboratory

scale: 1/8"=1'-0"

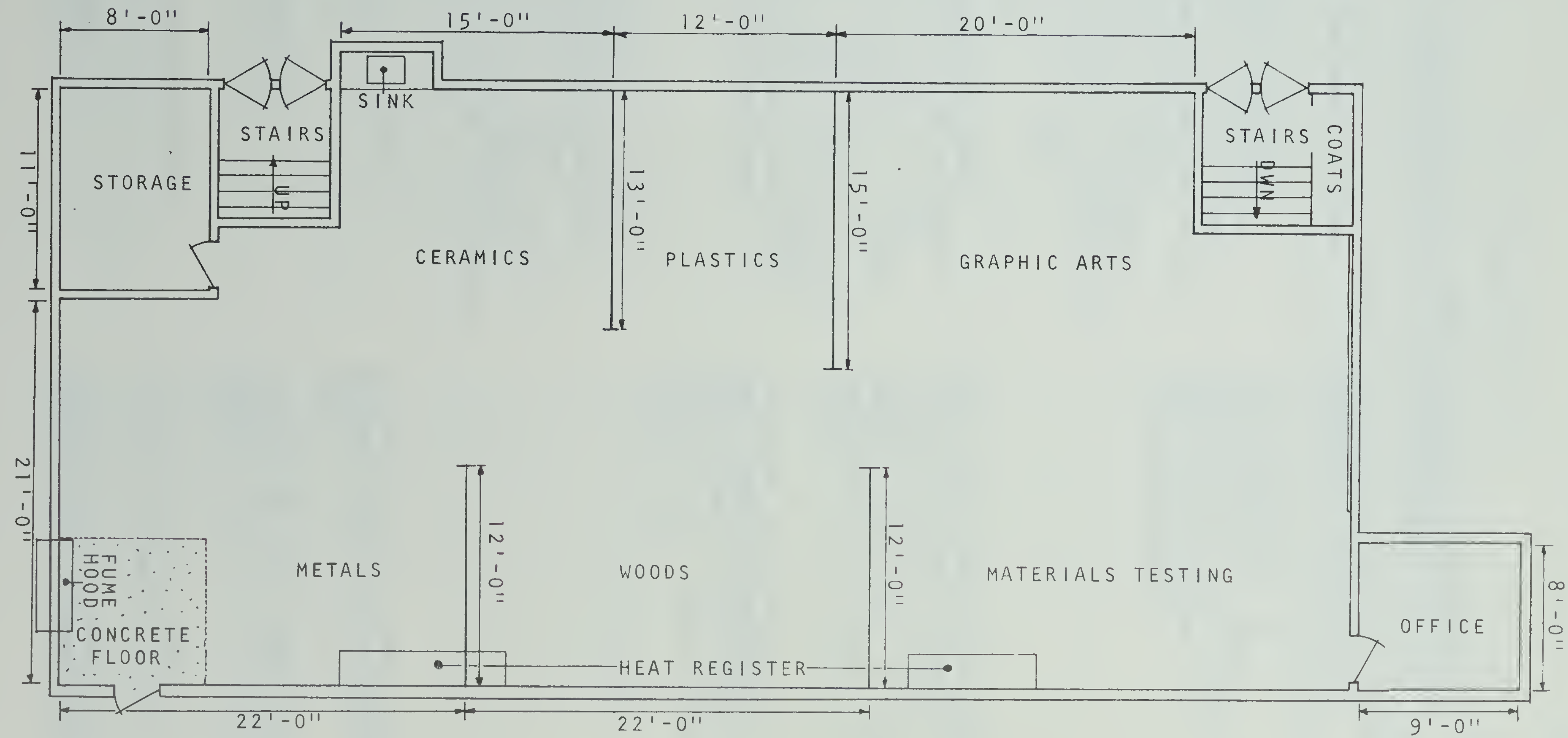

Table 16

Description of Physical Facility-Cartier McGee JHS Experimental Research Laboratory

Dept. of Ed. Recommendations	Comments--Description
1. Proportions and shape; Rectangular, this is the most commonly used shape and has many benefits which range from economy of construction to efficient interior layout. Proportions of 1:1 1/3 (1:1.33) to 1:1 1/2 (1:1.5) are recommended.	The laboratory is rectangular in shape. It's proportions are 1:1.26, very close to the recommendations.
2. The recommended area allotted for each student might be 150 sq. ft. for for junior high . . . where only one laboratory is provided. This would include auxiliary space for storage, conference room, wash area, office, and darkroom.	The total area provided for the Phase II section is 1960 sq. ft- This amounts to 98 sq. ft. per pupil taking a class size of 20. The area allotments per pupil when considering both Phase I and Phase II portions are approximately 228 sq. ft.
Area allotments: subject to other considerations, the areas in square feet recommended for the various units and services in a multiple activity laboratory are given below.	
Electronics-computer 200 sq. ft.	Is 224 sq. ft. about 1/6 larger than the recommended area.
Power mechanics 300 sq. ft.	Is 350 sq. ft. about 1/6 larger than the recommended area.
Graphic communications 400 sq. ft.	Is 324 sq. ft. about 4/5 of the recommended area.
Photography 100 sq. ft.	Is 144 sq. ft. about 2/5 larger than recommended.

Table 16 (continued)

Dept. of Ed. Recommendations	Comments--Description
Wood 350 sq. ft.	Not applicable
Graphic arts 150 sq. ft.	Not applicable
Metals 360 sq. ft.	Not applicable
Plastics 150 sq. ft.	Not applicable
Ceramics 150 sq. ft.	Not applicable
Materials testing 100 sq. ft.	When set up, it was about 80 sq. ft. of the power mechanics area.
Storage 240 sq. ft.	Is 126 sq. ft. about 1/2 of the recommended area.
Office 80 sq. ft.	Is 132 sq. ft. about 7/10 larger than the recommended area.
4a. Laboratory site: the site should be large enough for future expansion of the building.	This is the case. The laboratory can expand toward the parking lot.
4b. Each laboratory should have independent access from the main building, especially for students that are bussed in and for night classes.	Independent access is provided through the school as well as an outside entrance/exit.
4c. Laboratories should be above ground level.	The laboratory is at or close to ground level.
4d. Laboratories should be accessible from a service drive.	Direct vehicle access is not possible, but a side-walk leads to a parking lot.
5a. Laboratory plan: Laboratory areas for industrial arts should be planned for	An open area designed laboratory such as this one is most conducive to

Table 16 (continued)

Dept. of Ed. Recommendations	Comments--Description
5a. Continued	
flexibility so as to allow for the rearrangement of furniture and equipment.	the measure of flexibility demanded by an industrial arts course.
5b. Partition walls should be kept to a minimum.	This is the case. Only necessary walls are in.
5c. Partitions should be non-bearing and free of ducts, internal conduits, and pipes.	This is the case.
5d. All parts of the laboratory should have visual access from the main activity area.	The open area laboratory design is most conducive to visual access.
5e. Utilities should be placed on the perimeter walls where possible.	Electricity and water are so arranged. Air is supplied from a ceiling system.
5f. Provision should be made for these services to be extended or moved.	This appears to be the case, except for the water drain.
5g. Provision must be made for the removal of exhaust fumes where such are generated.	A small system is installed in the power mechanics area.
5h. Provision should be made for dust removal by either a built-in system, or by collectors placed on the machines.	Not applicable to Phase II.
5i. Technologies or material areas that are closely related should be placed in close proximity to each other.	This is the case. Graphic communications and photography are adjacent as are electronics and power mechanics.
5j. Provisions for a clock should be made.	A clock, easily visible, is installed.
5k. Spacing between benches and machines and other equipment should be sufficient for	This is generally the case except for some narrow aisles in graphic

Table 16 (continued)

Dept. of Ed. Recommendations	Comments--Description
5k. Continued	
student's safety and free passage.	communications.
5l. Safety zones should be clearly marked.	There are no safety zones in the Phase II laboratory.
<u>Structural considerations</u>	
6a. Walls, masonry construction, painted or plywood at least to 48" from the floor.	Walls are entirely of painted concrete blocks.
6b. Suitable sound absorbing material from there to the ceiling.	There is no sound absorbing material.
6c. Ceiling, height should be a minimum of 10' to the underside of beam, and covered with sound deadening insulation.	The ceiling height is adequate and of baffled design, but there is no deadener.
6d. Doors, proper exit doors as required by the fire regulations must be installed.	Two exits are provided double doors outside, and a single door to the hall.
6e. Coloring, a pleasing color scheme should be planned. Light colors are preferred.	The laboratory appears pleasing.
6f. Floors should be pleasing in appearance.	The floor is beginning to show wear.
6g. Floor materials by area:	
Electronics tile, wood	Wood floor.
Power mechanics painted concrete	Painted concrete.
Graphic communications tile, wood	Wood.
Photography tile, wood	The darkroom floor is tiled.

Table 16 (continued)

Dept. of Ed. Recommendations	Comments--Description
Graphic arts tile, wood	Wood.
Woods tile, wood	Not applicable
Metals concrete	Not applicable
Plastics tile, wood	Not applicable
Ceramics concrete with drain	Not applicable
Materials testing tile, wood, concrete	Was wood when it was set up.
Materials storage concrete	Concrete.
Office tile	Tile.
6h. A coat rack should be provided either in the corridor next to the laboratory or near the entrance to the laboratory.	A rack is provided just inside the laboratory entrance.
6i. An attractive display case should be built into the wall near the laboratory entrance and face the corridor.	No display case is so provided, however other display cases throughout the school may be shared.
6j. Moveable chalk and bulletin boards should be provided in strategic locations.	A large blackboard and bulleting board combination are provided in the lecture/conference area. A small one, moveable, is also used.
6k. Adequate storage needs to be provided for materials and student lockers.	Materials are stored in the storeroom and in the drawers and cabinets under the benches. The latter are also used for student projects.

Table 16 (continued)

Dept. of Ed. Recommendations	Comments--Description
61. Keyed class or student lockers are recommended.	There are no student or class lockers.
Special recommendations	
7a. Heating units should be of low noise level and of slow air movement type.	This appears to be the case.
7b. Registers should be accessible for cleaning.	Yes, but they are located in the ceiling.
7c. Closed areas such as the darkroom and the conference room should be adequately heated and ventilated.	The darkroom is heated and ventilated.
7d. Lighting should be adequate and safe. Artificial lighting should be provided at the intensity necessary for the activity.	The laboratory is brightly lit with fluorescent lamps.
General lighting 50 candle power	The general reading is 13-52 foot candles.
Machines individual lights	Not applicable
Darkroom safelights	Several are provided.
Electronics incandescent lamps	All lamps are fluorescent.
7e. At least one keyed master control switch to control all outlets except the lights, should be installed with at least one auxiliary panic button strategically placed.	The keyed switch and panic button are provided, but the latter is in an awkward location.
7f. Electrical outlets should be provided on every unbroken wall space of four feet or or more, at intervals of six to eight feet.	The laboratory is well provided with outlets except in the electronics area.

Table 16 (continued)

Dept. of Ed. Recommendations	Comments--Description
7g. Special wiring of 220 volts must be provided in areas as follows: woods, plastics, ceramics, materials testing.	The materials testing area did not have 220 volts.
7h. Floor outlets need to be provided for certain machines that must be placed away from the wall such as the jointer and the circular saw. These outlets should be recessed flush with the floor.	The hydraulics section of the power mechanics area needs these but they are not provided.
7i. Adequate washing facilities should be provided in each laboratory.	A half round treadle basin is provided as well as a washroom.
7j. Each laboratory should be provided with a drinking fountain.	This is provided.
7k. Use a regular developing sink in the darkroom.	A large stainless steel sink is provided.
7l. Cupboards with sinks built in, need to be permanently installed.	The sink in the power mechanics area is not in a permanently installed cupboard.
7m. As much of the furniture, work-tables, tool boards, etc., as possible, should be portable.	This is the case.
7n. Table tops in all areas are recommended to be 30" wide.	This is the case.
7o. A desk is required in the teacher's office.	This is provided.
7p. Equipment should be so placed that it can be safely be operated. Safety zones around each machine should be designated on the floor by painted lines or tape.	Equipment is generally well placed except for some narrow aisles in the graphic communications area. There are no safety zones in the Phase II laboratory.

Table 16 (continued)

Dept. of Ed. Recommendations	Comments--Description
7q. Equipment, except that which is portable, should be fastened securely to a bench or other stable foundation.	All the machines and test stands in the power mechanics area do not meet this standard.
7r. Equipment should be placed at a comfortable working height for the students.	This appears to be the case.
7s. Machines that create vibration should be cushioned with shock absorbing material and in most cases be placed on individual tables.	This is not the case with the test stands in the power mechanics area.

Fig. 8 Cartier McGee Junior High School Experimental Research Laboratory
scale: 1/8"=1'-0"

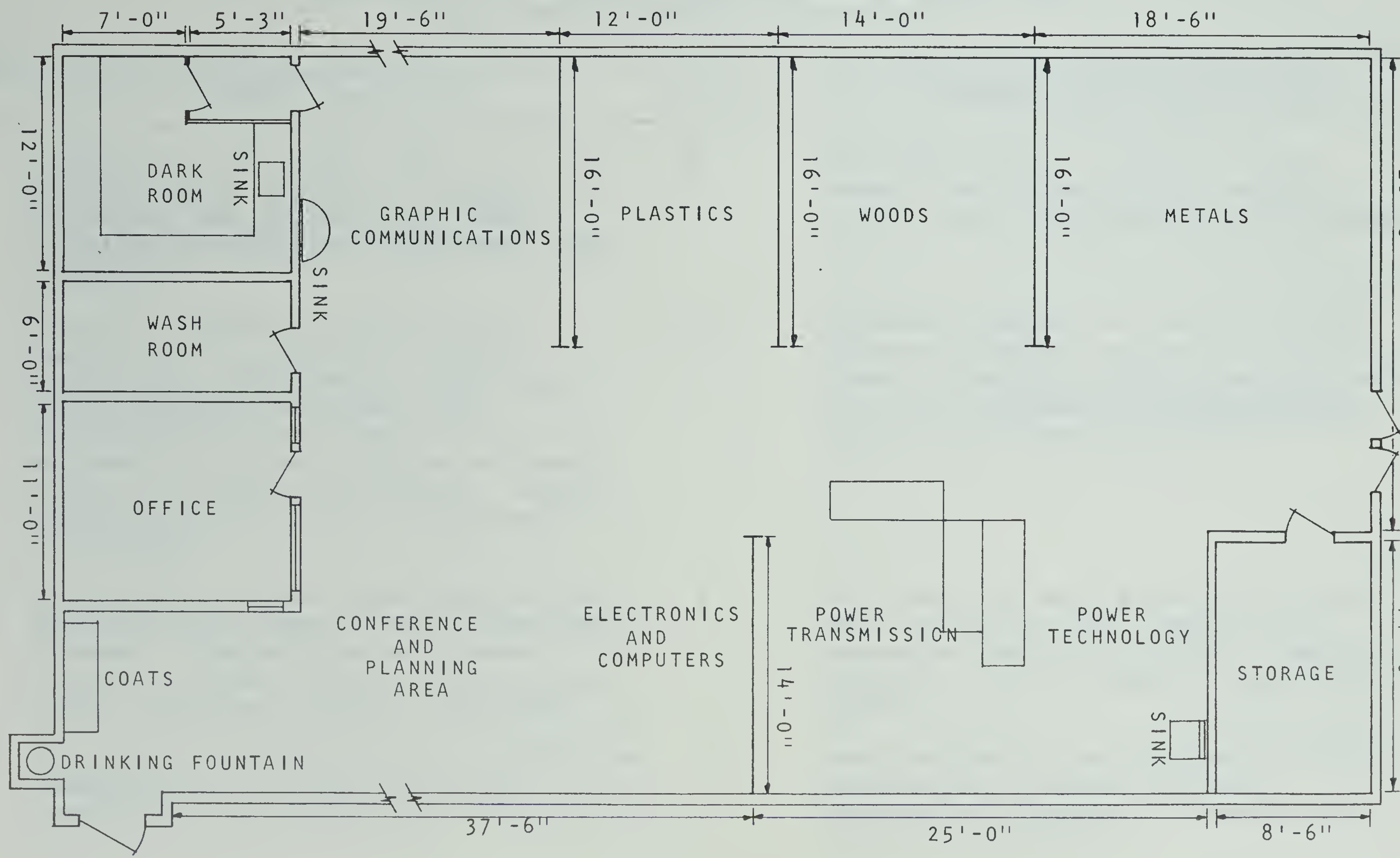

Table 17

Assessment of Physical Facility-King Edward JHS
Experimental Research Laboratory

NSSSE Item	Rating	Comments and Explanation
1. Industrial arts shops are appropriately located. Outside entrances are provided for the handling of supplies, equipment, and projects.	2c	The laboratory is below ground level, and there is poor outside access due to stairwell and railing.
2. Natural lighting is effectively controlled to eliminate glare. Sufficient supplemental artificial light properly diffused and distributed is provided for a minimum of 30 foot candles at bench height throughout the shops. Local lighting is provided in critical work areas.	2c	Natural lighting is restricted by blocked windows, but there is no glare. Overall lighting ranges from 8-25 foot candles at bench height. There is no local lighting.
3. Floors are in good condition and are suited to the area in which they are located. Precautions are taken against slippery floors, with machine areas receiving special attention.	1	The floor is well worn, and is not well suited to some areas, eg. ceramics (wood, no drain). No-slip pads are not provided in machine areas.
4. Facilities for heating and ventilation commensurate with good working conditions are available.	3	Heating facilities generally appear satisfactory except for the protruding registers. Ventilation could be improved.

Table 17 (continued)

NSSSE Item	Rating	Comments and Explanation
5. Exhaust ventilation equipment is available in areas producing excessive heat, fumes, dust, and gases.	1	This is not provided, only one unpowered fume hood is installed. Dust and smoke pose serious problems.
6. Where needed, adequate and properly located gas, water, electrical, and compressed air facilities are provided.	3	110 volt electricity, air, are provided around the laboratory. Water is available in plastics and ceramics while gas is restricted to the metals area.
7. Each school shop facility has a minimum of two entrance-exit doors with a width of 36" or more.	3	Two sets of inside double doors are provided, but the outside single door requires a step to reach it, this is not built in.
8. Ceiling height is appropriate, between 12 and 24 feet in all school shop and drawing rooms; and where applicable, ceilings are constructed of a material having a high coefficient of sound absorption.	4	This is the case.
9. A ventilated, fire-resistant cabinet is provided for the storage of combustible materials. A metal, self-closing container is provided for soiled rags. Each shop is equipped with appropriately located fire extinguishers of correct type and size.	3	No ventilated fire-resistant cabinet is available. Three extinguishers are mounted, and a safety container are provided.

Table 17 (continued)

NSSSE Item	Rating	Comments and Explanation
10. Shop walls are durable and easily cleaned from the floor to the top of door height. Sound absorbing materials are used on upper surfaces of walls, wherever amount of noise suggests special wall treatments.	2a	Painted concrete block walls are durable, but are dirty. No sound absorbing materials are used on the walls.
11. Washing facilities and drinking fountains of an appropriate size and location are provided.	1	No washing facilities (intended) or drinking fountains are provided. One sink in the ceramics area is used.
12. Display case of a sufficient size, properly lighted, and appropriately located, is provided.	1	None is provided specifically for industrial arts use, must share other school display cases.
13. Convenient office or desk space is provided.	4	An office, desk, and storage area is provided.
14. Filing space is located near the instructor's desk and is adequate for all necessary records, pamphlets, and illustrative materials.	4	A well constructed storage and filing space is provided in the office as well as steel cupboards and shelves just outside the office.
15. School shop contains convenient area located tool and supply centers, and where applicable, an adequate number of well-laid-out panels for special tools and machines.	1	The laboratory contains both general and specialized tool boards, but they are in poor condition and design improvement is needed. This is the case for most of the racks from the original university laboratory.

Table 17 (continued)

	NSSSE Item	Rating	Comments and Explanation
16.	Principles of color dynamics with moderation are followed throughout each of the shops and on equipment to avoid glare.	1	Color dynamics are not used, the laboratory generally needs painting, and the machines are not color coded.
17.	Safe storage is provided for all supplies; storage area accomodates full-length stock and all appropriate materials.	1	Storage area is small, and limited in capacity to handle large stock. It is not vented and does not provide paint and solvent storage space as per the fire regulations.
18.	Storage areas are provided for student projects under construction as well as for articles in the finishing and assembly stages.	1	Some storage area is provided but it appears inadequate. There is no storage area for finishing products.
19.	Lockers are adequate in number and size and location. They are spaced to avoid crowding.	0	No student lockers are available.
20.	Equipment is arranged with reference to the sequence of operations and their relationships to other areas. Adequate clearances, commensurate with the function of the machine, are provided around all equipment.	3	This is generally the case except that the machines are not orientated toward light as recommended, and some clearances and positioning suggestions were not followed.

Table 17 (continued)

NSSSE Item	Rating	Comments and Explanation
21. The school shop has approximately one third more work area stations than the maximum class enrollment in order to provide needed flexibility. Ample aisle space is provided.	3	There are approximately 25 work stations which is not quite one third over the class enrollment. Of course, this depends upon the functioning of all machines.
22. A finishing area with the following characteristics is provided in each shop where the facility is important; adequate in size, appropriately located, properly lighted and ventilated, easily supervised, and relatively free from dust.	0	No finishing area is provided for any of the material areas.
23. A demonstration and discussion area, with space for each student is provided in all shops.	1	An area near the main blackboard is available, but it is not permanently set up for this purpose.
24. Convenient shop library and planning facilities are located away from major noises and dirty areas of the shop. Adequate storage space is provided for the storage of books magazines and folders.	1	No planning facilities exist. Book and instructional material storage is provided. Library area is open to dust and noise.
25. Unit-type machines with self-contained motors are used throughout the industrial arts program; equipment is adapted to the size and maturity of the students, ie., height from the floor to	4	This appears to be the case. An exception might be the radial arm saw.

Table 17 (continued)

NSSSE Item	Rating	Comments and Explanation
25. Continued the working surface of a machine, size of a machine, horsepower, speed, and capacity.		
26. Appropriate and convenient film showing facilities are provided.	2b	Only for class showings, and then this must be specially set up. Individual or small group showings are difficult.
27. All power machines and manually operated equipment are provided with effective guards which are used by the operator at all times.	1	Not all equipment is provided with guards, and some of the guards provided are inadequate (buffer, lathe, shaper, bandsaw, grinder).
28. Conveniently located and appropriately painted switches or control boxes are provided on all power machinery.	3	Most switches are well positioned, but few are painted or coded.
29. A master electrical panel is conveniently and centrally located in each shop. All machines wired in with the building are protected for overload and undervoltage and are provided with disconnect switches. All machines are grounded.	3	Master panel and switches and controls are provided as recommended, some machines are not grounded where especially needed, eg. vacuum cleaner and laminating press.
30. All tools and equipment in school shops receive proper maintenance.	3	Not always. Little assistance is available.

Table 17 (continued)

	NSSSE Item	Rating	Comments and Explanation
31.	Appropriately marked safety zones are identified around machines and in areas of potential hazards.	0	There are no safety zones in the laboratory.
32.	Safety clothing and protective devices are provided.	2c	A limited quantity of limited quality items are provided (face shields, aprons, gloves).
33.	One or more well located permanent chalkboards ample in size and in good condition are provided in each school shop or drawing room.	4	One large classroom board and one small area board are provided.
34.	One or more well located tackboards ample in size and in good condition are provided in each school shop.	2a	Two are provided, but they are too high for access and visual reference.
35.	Motion picture, filmstrip, slide, opaque, and overhead projectors are available within the school when needed.	3	Some audio-visual equipment is located within the laboratory, the rest is available within the school.
36.	Industrial arts shops are clean and neat; good planning and organization are in evidence.	1	Cleaning appears to be a problem. Possibly caretaking needs more emphasis. Little planning and organization on the part of university personnel is in evidence.

Table 17 (continued)

Summated rating of laboratory	74
Maximum possible rating	144
Laboratory rating in percentage of the maximum possible rating	52%

and table 18 pertains to Cartier McGee JHS.

Instructional Equipment--Comparison

Method. For the equipment comparison, each laboratory was first compared to the Department of Education's recommendations item by item, and area by area. A sample page of this device is given in appendix F. For the purpose of reporting the results of the comparison, three categories of items were established. These categories were; (1) hand tools and other small items, (2) power tools, test equipment, and machines, and (3) additional items of the second category that are beyond the recommendations of the Department of Education.

Percentages indicating the degree of congruence between the department recommendations and the laboratory equipment were calculated for the first category. A verbal statement was made with respect to the state of the second and third categories. The use of a percentage figure with its implied accuracy is not intended to indicate a categorical state of equipping, but rather it is intended to assist in arriving at the overall assessments of each area and laboratory in each of the three categories.

Sample. The entire contents of the King Edward Junior High School Phase I laboratory as well as the equipment of the Phase II portion of the Cartier McGee Junior High School laboratory formed the sample and population for

Table 18

Assessment of Physical Facility-Cartier McGee JHS
Experimental Research Laboratory

NSSSE Item	Rating	Comments and Explanation
1. Industrial arts shops are appropriately located. Outside entrances are provided for the handling of supplies, equipment, and projects.	2b	The laboratory is well located but there is poor outside access for large materials and vehicles.
2. Natural lighting is effectively controlled to eliminate glare. Sufficient supplemental artificial light, properly diffused and distributed is provided for a minimum of 30 foot candles at bench height throughout the shops. Local lighting is provided in critical work areas.	3	There is no natural light, no glare, and no incandescent lamps in the electronics area. Fluorescent lighting is provided and it appears even. The reading ranges from 12-52 foot candles.
3. Floors are in good condition and are suited to the area in which they are located; precautions are taken against slippery floors, with machine areas receiving special attention.	3	The floors are generally suitable to the areas, however, no no-slip pads are provided in the power mechanics area.
4. Facilities for heating and ventilation commensurate with good working conditions are available.	4	This is the case.

Table 18 (continued)

NSSSE Item	Rating	Comments and Explanation
5. Exhaust ventilation equipment is available in areas producing excessive heat, fumes, gases, and dust.	2b	The darkroom and the power mechanics area have ventilation systems. The latter does not seem to be adequate.
6. Where needed, adequately and properly located gas, water, electrical, and compressed air facilities are provided.	4	This is the case.
7. Each school shop facility has a minimum of two entrance-exit doors with a width of 36" or more.	4	Two entrance-exits are provided, one outside double set, and one single door to the inside.
8. Ceiling height is appropriate, between 12 and 24 feet in all school shops and drawing rooms; and where applicable, ceilings are constructed of a material having a high coefficient of sound absorption.	3	The height is satisfactory, but there is no sound deadening material used.
9. A ventilated fire-resistant cabinet is provided for the storage of combustible materials. A metal, self-closing container is provided for soiled rags. Each shop is equipped with appropriately located fire extinguishers of correct size and type.	2c	No ventilated storage area is provided for combustible materials. One extinguisher and a fire hose is provided.

Table 18 (continued)

NSSSE Item	Rating	Comments and Explanation
10. Shop walls are durable and easily cleaned from the floor to the top-of-door height. Sound absorbing materials are used on upper surfaces wherever amount of noise suggests special wall treatments.	2a	The walls are painted concrete block. There are no sound absorbing materials used.
11. Washing facilities and drinking fountains of an appropriate size and location are provided.	4	A half-round treadle basin and a drinking fountain are provided as well as a separate washroom.
12. Display case of a sufficient size properly lighted, and appropriately located is provided.	1	Not specifically for industrial arts, a case must be shared with the rest of the users.
13. Convenient office or desk space is provided.	4	A large office and desk are provided.
14. Filing space is located near the instructor's desk and is adequate for all necessary records, pamphlets, and illustrative material.	4	Filing cabinet, bookcase, and cupboards are provided.
15. School shop contains convenient area located tool and supply centers; and where applicable, an adequate number of well-laid-out panel area for machines requiring special tools.	2c	Most supplies are in the storeroom. There are no tool panels in the power mechanics and electronics area.

Table 18 (continued)

	NSSSE Item	Rating	Comments and Explanation
16.	Principles of color dynamics with moderation are followed throughout each of the shops and on equipment to avoid glare.	1	Color dynamics are not used, but there is no glare.
17.	Safe storage is provided for all supplies; storage area accomodates full length stock and all appropriate materials.	2c	Storage space is limited, especially for large materials and combustibles.
18.	Storage areas are provided for student projects under construction as well as for articles in the finishing and assembly stages.	1	There is no finishing storage area that is applicable to Phase II. Pupil storage space is very limited.
19.	Lockers are adequate in number and size, and are located so as to avoid crowding.	0	No lockers are provided within the laboratory.
20.	Equipment is arranged with reference to the sequence of operations and their relationships to other areas. Adequate clearance commensurate with the function of the machine is provided around all equipment.	3	This is the case except for the graphic communications area.
21.	The school shop has approximately one third more work stations than the maximum class enrollment in order to provide needed flexibility. Ample aisle space is provided.	3	When all equipment is functioning this is the case, but there are generally only about 20 stations less than recommended.

Table 18 (continued)

NSSSE Item	Rating	Comments and Explanation
22. A finishing area with the following characteristics is provided in each shop where the facility is important; adequate in size, appropriately located, proper lighted and ventilated, easily supervised, and relatively free from dust.	n/a	Not applicable.
23. A demonstration and discussion area with space for each student is provided in all shops.	4	A conference area is permanently set up and used for this.
24. Convenient shop library and planning facilities are located away from major machine noises and dirty areas of the shop. Adequate space is provided for the storage of books, magazines, and folders.	2c	The conference area is used for this. It is open to dust and noise. There is no direct storage for materials and books.
25. Unit-type machines with self-contained motors are used throughout the industrial arts program. Equipment is adapted to the size and maturity of the student, ie., height from the floor to the working surface of a machine, size of a machine, horsepower, speed and capacity.	4	This appears to be the case.

Table 18 (continued)

NSSSE Item	Rating	Comments and Explanation
26. Appropriate and convenient film-showing facilities are provided.	3	The conference area is used for this purpose, but individual showings are not provided for.
27. All power machines and manually operated equipment are provided with effective guards which are used by the operator at all times.	2c	Couplings and exhaust lines are not guarded in the power mechanics area.
28. Conveniently located and appropriately painted switches or control boxes are provided on all power machines.	4	This is the case except for some controls on the test stands.
29. A master electrical panel is conveniently and centrally located in each shop. All machines, wired in with building, are provided with disconnect switches and have controls providing undervoltage and overload protection. All machines are grounded.	2b	Most of the criteria are implemented except for a large number of machines that are not grounded (press, some test instruments, hydraulics trainers).
30. All tools and equipment used in school shops receive proper maintenance.	3	Assistance is available from the school board.
31. Appropriately marked safety zones are identified around machines and in areas where there are potential hazards.	0	No safety zones are provided in power mechanics and graphic communications areas.

Table 18 (continued)

	NSSSE Items	Rating	Comments and Explanation
32.	Safety clothing and protective devices are provided.	2c	Some cloth aprons are provided, but no gloves or rubber aprons.
33.	One or more well located, permanent chalkboard, ample in size, and in good condition is provided in each shop or drawing room.	4	This is the case.
34.	One or more well located tackboards ample in size and in good condition is provided in each school shop.	4	This is the case.
35.	Motion picture, filmstrip, slide, opaque, and overhead projectors are available within the school when needed.	3	Equipment that is not available within laboratory is available in the school.
36.	Industrial arts shops are clean and neat, good planning and organization are in evidence.	3	There is good caretaking and the laboratory is generally neat. Organization is in evidence.
	Summated rating of laboratory	94	
	Maximum possible rating	140	
	Laboratory rating in percentage of maximum possible rating	67%	

the equipment comparison. In the case of the King Edward laboratory this was an adequate and accurate description, but in the case of the Cartier McGee laboratory, it was more difficult to estimate where the equipment for the Phase I portion of the electricity-electronics-computer area and of the graphic arts-graphic communications area stop, and the Phase II equipment began. This situation was handled according to the following rules. If an item was on the recommended list for the Phase II area it was considered to be a part of that area. An item not recommended for the Phase II area but recommended for the Phase I area was ignored, it was not included in the listing of additional equipment.

Comparison--King Edward JHS. With regards to furniture, the King Edward JHS laboratory is equipped as recommended by the Department of Education with the exception of certain specialized benches such as metal covered benches, paint benches, and layout benches. The laboratory does not maintain an area for lectures, class demonstrations, and film showings. The necessary space as well as chairs and tables are lacking.

Audio-visual equipment necessary for the presentation of information to the students is available either within the laboratory, or within the school. Some equipment is also available on loan from the University of Alberta Audio Visual Media Center. All of the audio-visual equipment

recommended is available in one of these ways. Of special interest is the equipping of the laboratory with an inter-communication system combined with area tape recorders. This is equipment additional to the departmental recommendations, and it offers great potential.

The summary of the equipment comparison will be given by area, using the three categories; (1) hand tools and small items, (2) power tools and equipment, (3) additional equipment, power tools, machines, and major items, beyond the Department of Education's recommendations.

Graphic arts. The graphic arts area is equipped as recommended in the 1967 Alberta Industrial Arts Equipment List and its supplement. There is no area by this name in 1969 Alberta Industrial Arts Equipment List. All the hand tools, power tools and equipment, recommended were available. The only items of importance that were not found in the laboratory were the teacher and student training kits for the offset press.

The equipment beyond the departmental recommendations did much to enlarge the scope of the area. Such equipment included an "embossograf," a platen press, and a spirit duplicator.

Plastics. Of the recommended hand tools and other small items, approximately 45% were not found in the experimental research laboratory. The bulk of these tools were measuring and layout tools. Some examples of these are: breakers, scales and combination square sets.

All of the recommended equipment is available except for a strip heater. However, a serious deficiency exists with respect to the useability and effectiveness of the machines and power tools. This is the lack of suitable molds and other small accessories. Over 50% of the molds for the plastics injection machines yield unacceptable products.

Two pieces of equipment over and above the department's recommendations provide extra work stations. These machines are the plasticor injector and the "engravograf."

Earths. Of the hand tool category, approximately 35% of the items recommended were not to be found in the ceramics area. The omitted tools were miscellaneous in nature and had no common element. The omission of all of the recommended items for the concrete and glass section, constitutes a serious decrease in the scope of the earths area.

All the machines and equipment recommended are in the area. A pug mill is also available. This item is beyond the recommended list. The only piece of equipment not available is an enameling kiln.

Metals. Only 70% of the recommended hand tools were in the metals area. Most of the remaining 30% could be classified as measuring and layout tools. The remainder of the missing tools were miscellaneous in nature.

Most of the power tools and machines recommended by

the department are in the area. Two exceptions were found, these were a power hacksaw, and a spot welder. However, more serious than these two exceptions, was the absence of some recommended accessories that normally increase the versatility of the machines in the area. A tapering attachment (lathe) and a vertical milling head (mill) are examples.

Equipment additional to the Department of Education's recommendations includes a Di-acro sheet metal bench set (slip rolls, notcher, box and pan brake, bender), a set of stakes, and two gas soldering furnaces.

Woods. Thirty three percent of the hand tools recommended by the Department of Education are not in the area. The bulk of these are layout tools and maintenance tools. Some safety items such as face shields and oily waste containers are also included in the 33%.

Most of the machines and power tools recommended by the department are in the laboratory. Exceptions to this are a tool grinder, a uni-plane, and a vacuum cleaner. Although one of the latter is provided, its effectiveness is minimal because of the lack of accessories adapting it to the various machines.

Two machines, the dia-press and a wood lathe, are provided beyond the departmental recommendations. The latter however, is also classed as optional by the department.

Testing. The materials testing area was not set up in the King Edward laboratory during the two year period

considered by this study. However, the equipment was moved there in the latter part of the 1969-1970 school year, and thus falls within the scope established for this study.

The equipment in the materials testing area consists of a polariscope and a Vega compression/tension testing machine. Both items mentioned are recommended by the department. Equipment also recommended but not available includes a heat treating furnace and a microscope.

Comparison--Cartier McGee JHS. The Cartier McGee laboratory presents a striking contrast to the King Edward laboratory. The former is completely new, whereas the latter is obviously a converted shop from another period of industrial arts education. The Cartier McGee furniture, for example, adheres closely to the recommendations of the department; much closer than King Edward's does. The only item missing in the former, with respect to furniture, is a mechanic's bench with a solvent tank.

With respect to the supplemental equipment, all recommended audio-visual items are available either within the laboratory or within the school. The major restriction in this area involves the provision of only one tape recorder. All other supplementary equipment is available.

Graphic communications. The graphic communications (Phase II) and the graphic arts (Phase I) areas are combined in the Cartier McGee laboratory. The end result is an extremely well equipped area for either phase. All the

recommended graphic communications equipment is available except for a selectric typewriter. In this case, it appears that the necessary supporting materials and equipment are available. A photo-copier, spirit duplicator, and drafting machine and table, all beyond department recommendations, further equip the area.

Photography. Almost all of the recommended small items are available in the area. This is also the case for the major equipment. Only three items of the latter category are not provided; a polaroid camera (optional), camera filters, and flood lights and stands. An extra enlarger, easel, spot-o-matic analyzer, two safelights and a print dryer total the equipment found in the area that exceeds the departmental recommendations.

Electronics--computer. Hand tools, small auxiliary items, and small test equipment are almost non-existent. Only 16% of the recommended items in this category are to be found in the area. For major equipment and testing apparatus, however, this is not the case. All of the recommended equipment is available except for a small digital computer simulator and a record turntable.

There is also a large amount of equipment provided over and above the department recommendations. Included in this category are a PDP-8 computer with teletype input-output, several power supplies, a set of EKS circuit demonstration boards, as well as some other test equpment such as radio

frequency and audio frequency generators.

Power mechanics. The percentage of the recommended hand tools available in the area is even smaller than the percentage available in the electronics area. The former is only 7%. Only 7% of the recommended handtools are available in the power mechanics area. Specialized tool kits recommended specifically for certain engines are not provided. Power sources, on the other hand, are all provided as recommended with only one two cycle engine not available. The instructional materials and kits for these power sources are recommended but not provided. Two generating units, a fuel cell and a solar generator are also provided.

Models in addition to the Department of Education's recommendations include; a car, a differential, a transmission and clutch, a steering box, and a large assortment of automat mechanical models. A complete automat set for building these and other models is also provided.

Four test stands are provided. They are not included in the recommended equipment list. They are of the early Go-Power series and do not include air and fuel measuring devices, thus limiting their usefulness drastically.

Instructional Material--Classification

Method. The classification method of analysis was used to provide information with respect to instructional material available in the experimental research laboratories. The

instructional materials were listed in table 19 by the quantity of each type and category combination. Both the presence and absence of instructional material can thus provide information.

Sample. All the instructional materials found in the two experimental research laboratories became the sample and population for the classification. In addition to this, items directly mentioned in the instructor and student interviews, but not actually found in the laboratory, were considered to have been found. This took into account the possibility of the use of borrowed materials.

Classification. The results of the classification process are given by table 19. The instructional material from both the experimental research laboratories are included within this table.

Achievement Measures--Application of Criteria

Method. The analysis of the Phase I achievement testing program followed the steps listed below.

1. Application of the criteria of reliability, validity, and objectivity to the Stanford Achievement Test.
2. Application of the criteria of reliability, validity, and objectivity to the industrial arts pre and post tests.

Sample. The entire achievement testing program

Table 19

Classification of Instructional Material-King Edward and Cartier McGee JHS Experimental Research Laboratories

Categories of Instructional Material	Types of Instructional Material									
	A-T	F	FS	M	PM	RR	S	SPI	S-T	TV
Machine and tool operation		5	1		18			13		
Processes basic to industry		2			14			2		
Jobs, careers, requirements		1			7					
Safety, safe operating procedures					1			1		
Materials, characteristics					10			1		
Organize the laboratory										
Labor, management, business		1								
Basic principles of technology				40	7			3		
Interrelate industrial arts										
Products, procedures, experiments				4	56			11		

Abbreviation code: A-T--audio-tape, F--film, FS--filmstrip, M--model, PM--printed material, RR--research report, S--slides, SPI--sequenced pictorial instruction, S-T--slide-tape, TV--television production.

employed by the Phase I research team became the sample for this study. The most appropriate method for describing this sample was to provide a summary of the achievement testing program as follows:

Two tests were administered by the Phase I research team. One was an industrial arts achievement test, and the other consisted of a battery of four sub-scales of the Stanford Achievement Test. The sub-scales administered were, the paragraph meaning scale, the arithmetic concepts scale, the science scale, and the study skills scale.

The construction of the industrial arts achievement test is documented in the Phase I Research Report (Dyrenfurth and Ible, November 1969) as follows:

> The questions were selected from multiple choice questions prepared previously by professors, university students, and industrial arts instructors in the field. The questions were selected on the basis of a criterion of general knowledge in each of the six areas of phase I. In order to meet this criterion, an affirmative answer was required to the following question; Is the student likely to have some information about this topic if he has not taken any industrial arts courses previously (p. 2)?

The industrial arts achievement test was administered as a pre and post test with no changes other than the deletion of one item. The Phase I research team administered the various settings of the test as did some members of the Phase II team. Conditions for these administrations were generally far from ideal, with lack of space and noise given as major problems. The Stanford Achievement test was administered under the same conditions.

Once the Stanford Achievement Test was administered, the results were analyzed by class and subscale. These results, in the form of raw scores, are given in table 20. The individual scale means for grade eight and nine were then converted to a stanine score with respect to the norms developed for the Stanford Achievement Test. These scores are reported in table 21. They indicate that with respect to the population that formed the norming group, the student sample enrolled in industrial arts at the King Edward Junior High School is average.

The data analysis applied to these results involved the determination of pre and post test means, variances, standard deviations, and reliabilities. An item analysis of each item was also conducted. The entire analysis was conducted using the computer facilities provided by the Division of Educational Research. The computer program used for the analysis was the DERS program Ø4.

Application of Criteria--Stanford Achievement Test

The criterion of reliability when applied to the Stanford Achievement Test must be considered with two aspects in mind. The first, one which the research team had no control over, is the test and scale reliability built into the device. This has been estimated by the test constructors and is based upon a sample of 1000 students in grade eight (USA). The reliabilities and standard error of measurement for each subscale are given in table 22. The second aspect,

Table 20

Stanford Achievement Test Results

Abbreviation code:

PM--paragraph meaning
AC--arithmetic conepts
S--science
SS--study skills

G--Garneau Junior High School
KE--King Edward Junior High School
P--Parkallen Junior High School

School	Grade	Scale	Max	$\overline{X}$	S^2	SD
G	8A	PM	60	31.12	109.27	10.45
		AC	40	22.17	44.41	6.66
		S	60	38.62	28.84	5.37
		SS	40	26.62	28.84	5.37
G	8B	PM	60	29.71	118.37	10.88
		AC	40	22.64	57.78	7.60
		S	60	29.21	80.80	8.99
		SS	40	20.64	55.63	7.46
G	8C	PM	60	32.50	79.04	8.89
		AC	40	19.78	35.41	5.95
		S	60	35.50	107.50	10.37
		SS	40	22.21	47.10	6.86
G	8A, 8B, 8C	PM	60	31.14	95.78	9.75
		AC	40	21.58	45.62	6.75
		S	60	33.75	90.59	9.52
		SS	40	22.30	47.76	6.91

Table 20 (continued)

School	Grade	Scale	Max	$\overline{X}$	S^2	SD
KE	8A	PM	60	36.20	64.70	8.04
		AC	40	18.40	27.80	5.27
		S	60	38.80	54.70	7.39
		SS	40	23.20	8.20	2.86
	8B	PM	60	32.00	87.71	9.36
		AC	40	22.75	10.78	3.28
		S	60	34.87	70.12	8.37
		SS	40	20.00	27.33	5.23
KE	8C	PM	60	27.73	79.02	8.89
		AC	40	16.70	45.79	6.77
		S	60	28.18	71.76	8.47
		SS	40	17.90	19.09	4.37
KE	8A, 8B, 8C	PM	60	30.92	83.64	9.14
		AC	40	19.17	34.79	5.90
		S	60	32.21	81.04	9.00
		SS	40	19.74	21.56	4.64
P	8A	PM	60	35.50	90.27	9.50
		AC	40	23.06	50.73	7.12
		S	60	31.12	129.72	11.39
		SS	40	23.44	67.99	8.24
P	8B	PM	60	35.46	95.27	9.76
		AC	40	23.53	43.84	6.62
		S	60	34.64	111.78	10.57
		SS	40	24.20	71.03	8.43

Table 20 (continued)

School	Grade	Scale	Max	$\overline{X}$	S^2	SD
P	8A, 8B	PM	60	35.48	89.59	9.46
		AC	40	23.29	45.88	6.77
		S	60	34.64	111.78	10.57
		SS	40	24.84	55.94	7.48
G+KE+P	All 8	PM	60	32.56	92.96	9.64
		AC	40	21.55	44.52	6.67
		S	60	33.01	96.21	9.80
		SS	40	22.52	46.85	6.85
KE	9C	PM	60	38.20	50.88	7.13
		AC	40	25.14	31.98	5.65
		S	60	38.78	88.64	9.41
		SS	40	26.64	18.86	4.34

Table 21

Stanford Achievement Test Raw Score Conversion to Stanines
--Grade Test Means--

Stanford Achievement Test Sub-scale	Raw Score	Grade Score	Stanine Score
Paragraph Meaning	* 33	78	5
	+ 38	90	5
Arithmetic concepts	* 22	86	6
	+ 25	99	6
Science	* 33	80	5
	+ 39	100	6
Study Skills	* 23	(86)	(6)
	+ 27	(103)	(6)

* indicates test mean for all grade eights in sample
+ indicates test mean for all grade nines in sample

Bracketted numbers () serve only as a rough estimate. There was norming data available for the use of the study skills sub-scale alone, therefore the bracketted numbers are the result of interpolations from other scales with approximately the same characteristics.

The conversion is based on norming distributions provided in the Stanford Test Manual (Kelley, et al., 1964).

Table 22

Reliability Coefficients for the Stanford Achievement Test

Test Scale	KR_{20} *	SE_m +
Paragraph Meaning	.93	8.0
Arithmetic Concepts	.87	8.0
Science	.89	10.5
Study Skills (Social Studies)	.91	10.5

* indicates estimate of Kuder-Richardson 20 using Saupe's formula.

+ indicates standard error of measurement is in terms of grade scores.

All data presented in this table is from the Stanford Achievement Test Manual (Kelley, et al. 1964, p. 24)

the one dependent upon the research team, involves the variables of test administration and testing conditions. This aspect may have weakened the total instrument reliability due to the poor testing conditions, and minimal student motivation, but there exists no clear precise way of estimating the effect these factors have had on reliability.

The Stanford Achievement Test Manual (Kelley, Maden, Gardner, and Rudman, 1964) states that the criterion of content validity must be assessed in terms of the particular curriculum of the students tested, even though;

> The Stanford authors sought to insure content validity by examining appropriate courses of study and textbooks as a basis for determining the skills, knowledges, understandings, etc. to be measured (p. 24).

There is no record of the checking of the content validity of the Stanford Achievement Test in any of the materials produced by the research staff, thus the possibility of a weakened validity exists in spite of the fact that the test appears to be valid (face validity).

The criterion of objectivity was met as a result of the test being multiple choice in nature, machine scored, and interpreted with respect to norm data.

Application of criteria to the industrial arts achievement test. Reliability was the first criterion applied to the industrial arts achievement test. One indication of its reliability is given by the estimates resulting from the item analysis of the pre and post test scores. These estimates were arrived at by using the Kuder-Richardson

formula 20. This was an integral element of the item analysis program Ø4. The calculated reliabilities are reported in table 23. The fact that the pre and post test reliabilities are almost the same provides evidence of the stability of the test. Although the reliability is lower than what the researchers would like (approximately .85 and higher is recommended for a multiple choice achievement test by Noll, 1957, p. 73), one must remember that these calculations are based upon the rational equivalence of individual test items, a method that generally yields a lower reliability estimate than other methods (Borg, 1963, p. 86). The similarity of the pre and post test score distributions as evidenced by the histograms generated by the program Ø4, is further indication of the reliability of the test. The variances and standard deviations given in table 23 document this.

The reliability of the test, however, can be challenged on the basis of the lack of standardized instructions given the various classes by the different test administrators. From the reports (verbal) of the test administrators, it appears that proper motivation was not consistently achieved. Conditions such as discomfort and noise certainly do not contribute to the test's reliability.

The criterion of validity, because of its important nature (Kerlinger, 1964, p. 446) (Fox, 1969, p. 367) must be applied to the industrial arts achievement test. Of the various types of validity, only content will be investigated. Content validity refers to the representativeness of the

Table 23

Industrial Arts Achievement Test Results

School	Grade	Test	Max	$\overline{X}$	S^2	SD	KR-20
G+KE+P	All 8 & 9	Pre	71	29.94	55.32	7.44	.740
G+KE+P	All 8 & 9	Post	70	32.17	58.56	7.65	.748

Abbreviation code: KR-20--reliability estimate using Kuder-Richardson formula 20

G--Garneau Junior High School

KE--King Edward Junior High School

P--Parkallen Junior High School

Max--the maximum attainable score on that particular test.

test items. Because the test items were selected by a single researcher, the validity of the test is dependent upon this individual's perceptions of what the content of an industrial arts course based upon the industrial arts rationale would be. In view of the absence of any coherent description of suggested content, that is, content at any level of useable specificity, the importance of the item selector's perceptions became increased.

Based on an examination of the content of the items in the industrial arts achievement test, each area was found to have questions pertaining to it. The number of questions applying to each area is given in table 24. In view of the fact that the electricity area was not taught during the two year period encompassed by this study, it seems that the inclusion of questions pertaining to this area definitely lowered the test's content validity. Also lowering the content validity of the test is the fact that the proportion of items for each area is not even. Without any evidence to the contrary, there appears to be no reason for the wide range (29%--electricity, to 10%--metals, graphic arts, ceramics) in proportion of items per area.

When the content of the questions was classified at face value, according to the objectives of the industrial arts rationale and Phase I, the result was another uneven distribution as evidenced in table 25. This uneven distribution does not appear to have any justification based on the objectives of the industrial arts rationale, because

Table 24

Classification of Industrial Arts Achievement
Test Questions by Area

	Area						
	W	M	P	GA	E	C	G-K
Number of questions applying to area	19	7	8	7	20	7	2

Abbreviation code:

W--woods, M--metals, P--plastics, GA--graphic arts, E--electricity, C--ceramics, G-K--general knowledge.

Table 25

Classification of Industrial Arts Achievement
Test Questions by Objectives

Objectives of the Industrial Arts rationale	Phase I Objectives	Number of Questions
	Safety	1
Exploring productive society	Machines and tools	6
	Materials	34
	Processes	19
Providing a synthesizing environment	Providing a synthesizing environment	9
Reinforcing academic disciplines	Reinforcing academic disciplines	
Introducing career information	Introducing career information	1

the latter does not indicate or imply any weighting among individual objectives.

Because there were no relevant outside criteria available, an assessment of the industrial arts achievement test's construct, concurrent, congruent, and predictive validity was not possible. Also, in view the findings with respect to content validity, the value of investigating the other forms of validity is questionable.

The industrial arts achievement test met the criterion of objectivity in several ways. First, it was constructed of multiple choice questions with a standard key applied to all answer sheets. The students recorded the answers on optical scoring sheets which were subsequently processed and scored by the IBM optical scorer available as a service from the Division of Educational Research. The IBM scorer punched data cards which were subsequently analyzed by the DER's program Ø4. Because there were no possibilities of bias entering the scoring procedures, the degree of objectivity was taken to be high.

Chapter 5

Summary, Conclusions, and Recommendations

Summary

The purpose of this study was to provide information necessary for increasing the effectiveness of the Department of Industrial and Vocational Education's experimental research program, and by these means, ultimately improve the Department's industrial arts teacher education program. The problem investigated to achieve this purpose was to describe and evaluate selected aspects representative of the experimental research program conducted by the Department's research team.

The aspects selected for study included; instructional material and teaching methods as they related to instructional material, instructional equipment, physical facilities, achievement measures, and the administration of the experimental research program. These five aspects were investigated as they existed within, or applied to, the experimental research laboratories, the experimental industrial arts program, and the experimental research program, all of which were operationally defined for this study.

The instruments used to investigate these aspects, included the following:

1. A student interview to obtain information about instructional materials, student reaction, and the experimental research program.
2. An instructor interview to obtain information about teaching methods, instructional material, instructional equipment, student achievement measures, and the experimental research program.
3. The application of criteria to the achievement measures used in Phase I.
4. A description of the experimental research laboratories' physical facilities.
5. An assessment of the physical facilities of the experimental research laboratories.
6. A comparison of equipment in the experimental research laboratories to that recommended by the Department of Education.
7. A classification of the instructional materials in the experimental research laboratories.

Each of these instruments gathered data directly dealing with one or more of the aspects selected for investigation. Each aspect had at least two sources yielding direct information about it and an auxiliary source of indirect information.

Specific conclusions with respect to each of the selected aspects were arrived at in the following manner. The use of the described method synthesized the results of the direct and indirect sources of data for each aspect.

Thus the findings and conclusions were drawn on the basis of the broadest base of information available as a result of this study.

1. The result of the content analysis process of both the student and instructor interviews as well as the classification of instructional materials was used to arrive at the general conclusions about the instructional materials and teaching methods aspect.
2. The equipment comparison and the results of the content analysis of both student and instructor interviews formed the basis of the conclusions pertaining to the instructional equipment aspect.
3. To arrive at the conclusions about the achievement measures aspect, the results of the content analysis of both student and instructor interviews were considered along with the findings resulting from the application of the criteria to the achievement measures.
4. To arrive at an overall conclusion with regards to the instructor and student reaction to the experimental research program, the results of the content analysis of both instructor and student interviews was used.
5. To arrive at the conclusions about the physical facilities aspect, the results of the content analysis of the instructor and student interviews were used as well as the laboratory descriptions and

the NSSSE checklist and scale.

Major Findings

The findings included in this section constitute a summary and selection of the most important facts the data pointed out. These findings represent data, without any interpretation or coloring on the part of the researcher.

Findings with respect to Instructional Materials--Student

1. Student responses (table 8) indicated that most would like more varied products that demonstrate course objectives.
2. Student responses (table 8) indicated that most would like to choose, design, and make their own products rather than pre-designed ones.
3. Students generally indicated (table 8) that there was a sufficient number of books available.
4. Most students indicated that (table 8) a greater quantity and a greater variety of instructional material was needed.
5. Students indicated (table 5) that direct instructor activity (lecture, demonstration) was the most frequently employed teaching method.
6. Students indicated (table 5) that printed materials (SPI, PPI, books, etc.) were the most frequently used type of instructional material.
7. Very few students indicated (table 5) the use of models, audio-tapes, research reports, slides,

slide-tapes, and television.

8. Most students indicated (table 5) that the most common use of instructional material was to learn machine and tool operation and to learn about safety and safe operating procedures.
9. Few students indicated (table 5) the use of instructional materials to learn about processes, jobs and careers, laboratory organization, and the interrelating of industrial arts to itself as well as to other school offerings.
10. Students indicated (table 5) that of the different types of instructional materials, they enjoyed films and slide-tapes the most.
11. Students indicated (table 5) that instructor demonstrations were the most effective in learning. Films and models were indicated as a close second.
12. Students indicated (table 5) that they would like to see more films and SPI's used.

Findings with respect to Instructional Material--Instructor

1. Instructors indicated (table 9) that they did not use slides, slide-tapes, and television.
2. Instructors indicated (table 9) that films and printed materials were the most versatile, that is, they were used for the instruction of the greatest variety of activities.
3. The instructors indicated (table 9) that they used

the greatest variety of instructional material for the instruction of processes and machine and tool operation.

4. Instructors indicated (table 12) that the class lecture was the teaching method used for most types of activity.
5. Instructors indicated (table 12) that field trips, audio-visual presentations, programed presentations, and independent study were used for few of the activities.
6. Instructors indicated (table 10) that students dislike to read, and that they classified books, SPI's, PPI's, and printed material in the same category.
7. Instructors indicated (table 10) that the time required to prepare television productions, film-strips, audio-tapes, slide-tapes and tours is prohibitive.

Findings with respect to Instructional Material--General

1. The vast majority of instructional materials were classified (table 19) as printed material.
2. Very few instructional materials of a type other than printed materials and models were available and classified (table 19).
3. The content of most of the classified instructional material was found (table 19) to pertain to

procedures, experiments, and product making.

4. Few or no materials were classified in the categories of; interrelating industrial arts to itself and to other school offerings; labor and unions, business and organization; and safety (table 19).

<u>Findings with respect to the Physical Facilities</u>

1. The King Edward experimental research laboratory's physical facilities were rated at 52% of the maximum attainable by the NSSSE scale (table 17).
2. The Cartier McGee experimental research laboratory's physical facilities were rated at 67% of the maximum possible by the NSSSE scale (table 18).
3. The students indicated (table 8) that the King Edward experimental research laboratory should be larger.
4. The students indicated (table 8) a need for improved ventilation and dust control in the King Edward experimental research laboratory.

<u>Findings with respect to Instructional Equipment</u>

1. Instructors indicated (table 11) that the most effective instructional equipment was that which produced quick products, such as the lathes, injection presses and the sign press.
2. The experimental research laboratories were found (on the basis of the equipment comparison) to be generally equipped with power tools, machines, and

equipment, as recommended by the Department of Education.

3. The experimental research laboratories were found (on the basis of the equipment comparison) to include equipment of the power tool, machine and equipment category, that was beyond the Department of Education's recommendations.
4. The experimental research laboratories were found (on the basis of the equipment comparison) to require the addition of accessories and supporting items necessary to insure optimal use of the equipment available.
5. The experimental research laboratories were found (on the basis of the equipment comparison) to require extensive additions to their stock of hand tools and other such small items in order to meet the Department of Education's recommendations.
6. The instructors indicated (tables 11 and 12) that a problem existed with regards to equipment breakdowns and maintenance.

Findings with respect to Achievement Measures

1. Instructors indicated (table 13) that observations were frequently used as a basis for determining a student's mark and overall standing.
2. The results of the Stanford Achievement Test show (table 21) the students enrolled in industrial arts

Phase I at King Edward JHS to be of average achievement, with scores at the fifth and sixth stanine.

3. The reliability of the Stanford Achievement Test is given by the publishers as ranging from .87 to .93 when using the Kuder-Richardson formula 20.
4. The content validity of the Stanford Achievement Test was not determined by the research team.
5. The reliability of the Industrial Arts Achievement Test (pre and post) was determined to be .7401 and .7483 when using the Kuder-Richardson formula 20.
6. There appear to be some grounds upon which to challenge the content validity of the Industrial Arts Achievement Test.
7. A lack of planning was evidenced in the construction, administration, and analysis of the Industrial Arts Achievement Test.

Findings with respect to the Experimental Research Program

1. Both instructors indicated (table 14) they had little or no interaction with their school board or with the University of Alberta's Department of Industrial and Vocational Education before and while the program commitments were drawn up.
2. It was indicated (table 14) that the commitment of instituting new programs and curriculum material was not kept.

3. Both instructors indicated (table 14) that there were no commitments between the school board, the school administration, and themselves.
4. Both instructors indicated (table 14) the experimental research program was mis-directed and mis-administered and disorganized.
5. Both instructors indicated that they had difficulty in seeing how the Department of Industrial and Vocational Education had benefitted as a result of the research program (table 14).
6. Both instructors indicated that in case of another research program, they would want to see the entire proposal, objectives, and organization before agreeing to cooperate.

Conclusions

Conclusions with respect to Instructional Material

The students indicated (table 8) a desire to select products from a more varied list and then to design and make "their" own products. These findings indicated that the students view the product as an end in itself, and not as a vehicle to be used to assist learning. The conclusion that must also be drawn is that the students either did not accept, or that they were not orientated to, the objectives of the industrial arts program.

Instructors indicated (table 10) that the preparation time required for audio-visual presentations and tours was

prohibitive in view of the other activities necessary to instruct and to operate an industrial arts multiple activity laboratory.

The amount of printed material (instructional) available in the experimental research laboratories was out of proportion with respect to the other instructional material in the laboratories. This conclusion is supported by the findings in table 19, indicating that the vast majority of instructional material classified was of the printed material type. Students indicated (table 5) that of the various instructional materials, printed materials were used most often. Students also stated (table 8) that there were "a lot of books available." In view of the finding (table 10) that students generally dislike to read, the large proportion and frequent use of printed materials is difficult to justify.

The previous finding and conclusion can be explained however, by the further conclusion that there was actually very little experimenting with, and production of, instructional material of different types. Support for this conclusion is drawn from the students' responses indicating (table 5) the infrequent and restricted use of models, audio-tapes, research reports, slides, slide-tapes, and television productions. The conclusion is further supported by the instructors who indicated they did not use slides, television, and slide-tapes as instructional material. The actual classification of instructional material (table 19)

was the evidence that supported this conclusion most directly. Of the instructional material classified, the majority was printed material. In addition to the fact that limited types of instructional material were available, many of the available materials were of poor graphic quality, were designed for other equipment and situations than what was found in the laboratory, or were intended for university use. In summary, many of the instructional materials were not directly applicable to the experimental research laboratory setting.

A trend became evident to the researcher while classifying the instructional material. This trend indicates a stereo-typing of instructional material is occurring. It appears that the trend exists in two conditions, one general, and one specific. The general condition is characterized by the use of instructional materials for only some specific categories of activities. The specific condition is characterized by the use of a certain type of instructional material for only a rather limited category of activity. Possibly the best example of the latter condition would be the use of SPI's almost exclusively for machine operation and product making. The existance of the general condition of stereo-typing is supported by the student responses (table 5) indicating that a large majority of instructional material were used for learning and teaching of machines and tool operation as well as safety and safe operating procedures, two activities inherently linked. Also

supporting the conclusion of stereo-typing are the instructor's responses in table 9, indicating that they used instructional material most often for the instruction of machine operation and processes.

On the basis of the preceding argument, another conclusion is reached. There is a need for more instructional material of all types. Students indicated (table 5) that the most frequent "learning" took place through direct instructor interaction, lecture, and demonstration. Although it is recognized that this is probably desirable, and in fact, that the students desire more individual instructor attention (table 8), more efficient use of the instructor's time would result if a greater quantity and variety of instructional material were available. Student's probably recognizing this point, also indicated that they would like to see more instructional material or a greater variety (table 8).

With respect to the content of the available instructional material, the conclusion was reached that certain content areas suggested by the objectives of the industrial arts rationale were not a significant part of the experimental industrial arts program. Student response indicated (table 5) that the categories of processes, jobs and careers, and interrelating industrial arts were infrequently the basis of content for instructional material. The classification of instructional material (table 19) indicated the lack of representation in the categories of;

interrelating industrial arts, business, labor, and management, safety, and jobs and careers.

Conclusions with regard to the Physical Facilities

Only one conclusion was reached pertaining to the physical facilities of the experimental research laboratories. With the ratings of 52% and 67% for King Edward and Cartier McGee experimental research laboratories, the only conclusion that can be reached is that these laboratories definitely do not present a "model" for the province as was once their objective (appendix B).

Conclusions with respect to Instructional Equipment

The experimental research laboratories at King Edward and Cartier McGee Junior HIgh Schools are not equipped as recommended with respect to the category of hand tools and other small items. These laboratories require extensive additions in this category of tools before they meet Department of Education recommendations. With respect to power tools, machines, and equipment, both of these laboratories are generally equipped to meet or better the Department of Education's recommendations.

Some of the effectiveness of this state of equipping is lost however, because of the lack of maintenence and consequently lengthy down time. The instructors have indicated the existance (table 11) of this problem when discussing equipment effectiveness. The lack of some accessories and supporting equipment also results in decreased

effectiveness of power tools, machines and equipment.

As a result of the investigation into the instructional equipment aspect, it was concluded that there was little or no systematic experimentation or research conducted with respect to equipment effectiveness and equipment requirements for industrial arts. This conclusion is supported by a complete lack of any indications to the contrary.

Conclusions with respect to Achievement Measures

It was concluded that a lack of planning, design, and control with respect to the Phase I achievement testing program was the case. This conclusion is supported by the low estimated content validity of the Industrial Arts Achievement Test, by the apparent poor student motivation towards the testing program, and by the lack of control in the design.

On the basis of the Industrial Arts Achievement Test's apparent content validity and reliability, it was concluded that the test could only serve as a point of departure for future achievement tests.

Conclusions with respect to the Research Program

The instructor reactions indicated in table 14 require the conclusion that the planning and choosing of schools and instructors followed inappropriate procedures with respect to insuring maximum instructor motivation and cooperation. Student responses (tables 6 and 7) indicated that there was

considerable diversity of information and opinion about the experimental research program. If the students were to be motivated, a proper orientation assuring consistent information would have been necessary. As this was not the case, the conclusion that both students and instructors were "on the sidelines" with respect to the experimental research program's planning and implementation certainly appears justified.

The finding (table 14) that there were commitments made that were not kept; in particular the commitment by the Department of Industrial and Vocational Education to produce, introduce, and evaluate new programs in industrial arts; reinforces the conclusion indicating inadequate planning and a lack of experimentation and research. With respect to this latter conclusion, both instructors indicated that they had difficulty in seeing the benefits to the Department of Industrial and Vocational Education that resulted from the experimental research program.

The researcher concludes with respect to this point, that the main results and benefits of the experimental research program were the exposing of many of the pitfalls and critical factors of this rather specific research situation. The benefit of the experimental research program rests on the ability and willingness of future researchers and planners to note the discovered pitfalls and critical factors and design accordingly.

Recommendations

Assuming that the content of the industrial arts courses advocated by the industrial arts rationale cannot adequately be delineated and developed by fragmented action on the part of various individuals, and that the development of this content is necessary to both the industrial arts teacher education program and the industrial arts research program at a school level, the researcher suggests that the Department of Industrial and Vocational Education concentrate on the development of curriculum and on the designing of a complete research proposal. To elaborate, the researcher specifically recommends that:

1. The Department of Industrial and Vocational Education terminate its agreement to conduct research in the Edmonton school systems and that this be done in a manner agreed upon by all parties involved.
2. The entire Department of Industrial and Vocational Education concentrate its efforts and resources on the development and dissemination of curriculum proposals at a detailed level of specificity that includes activities, resources and objectives, as well as a means of evaluating the achievement of these objectives.
3. The Department of Industrial and Vocational Education then develop a model designed to determine the evaluation of curriculum materials activities, and other factors, as well as evaluating the congruence

of the developed materials with the industrial arts rationale.

4. The Department of Industrial and Vocational Education then plan a research project implementing the evaluative model and the curriculum proposals. This planning of the research project must involve all parties concerned. There must also be suitable controls established.

5. The Department of Industrial and Vocational Education, upon completion of the previous recommendations, would then conduct the research projects as planned.

Concluding Statement

The purpose of this study was to provide information necessary to increase the effectiveness of the experimental research program. During the investigation of the problem and its selected aspects much information was gathered and noted. Although it might seem that the study is overly negative, the pitfalls and critical factors discovered must be heeded by future researchers in their planning of new programs. The necessary condition that this may occur, requires documentation of what went on in the past so that it can be studied and evaluated so as to better plan for the future. It was the intent of this study to provide this documentation, and as such, it is a necessary element preceding future research programs.

REFERENCES

References

Adams, F. C. A planning project to develop new/improved techniques for evaluating elementary and secondary schools, final report. Western Association of Schools and Colleges, Burlingame, California. Sponsored Office of Education, DHEW. Eric # 030-187.

Alkin, M. C. Towards an evaluation model--a systems approach. California University, Los Angeles, 1967. Eric # 014-150.

American Council of Industrial Arts Teacher Education. Research in industrial arts. Bloomington: McKnight, 1960.

American Council of Industrial Arts Teacher Education. Evaluation guidelines for contemporary industrial arts programs. Bloomington: McKnight, 1967.

Association for Supervision and Curriculum Development, Yearbook committee. Evaluation as feedback and guide. Washington, D.C.: ASCD, 1967.

Bateson, W. M., & Stern, J. The functions of industry as the basis for industrial education programs. Journal of Industrial Teacher Education, 1963, 1(1), 3-16.

Borg, W. R. Educational research: An introduction. New York, David McKay, 1963.

California Coordinating Unit for Occupational Research and Development. Evaluation in vocational education, Research summary. Sacramento, 1967. Eric # 025-587.

Cochran, L. H. Innovative programs in industrial education. Bloomington: McKnight, 1970.

Coutts, H. T. A letter to Mr. G. Sanders of the Edmonton Public School Board. April 9, 1970.

Department of Education, Alberta industrial arts equipment list. Edmonton, Department of Education, May 1967.

Department of Education. Industrial arts laboratory planning. Edmonton: Department of Education, 1968.

Department of Education, Alberta industrial arts equipment list. Edmonton: Department of Education, 1969.

Department of Education. Supplement to the May 1967 Alberta industrial arts equipment list. Edmonton, Department of Education, (no date).

Dixon, W. J., & Massey, F. J. Introduction to statistical analysis. Toronton, McGraw-Hill, 1969.

Dyrenfurth, M. J., & Ible, D. Phase I research report. Unpublished report to the Department of Industrial and Vocational Education. University of Alberta, Sept.-Nov., 1969.

Eidell, T. L., & Klebe, J. A. Annotated bibliography on the evaluation of educational programs. Oregon University, Eugene, Eric Clearinghouse on Educational Administration. Sponsored by Office of Education, DHEW, Washington D.C. 1968, Eric # 025-857.

Face, W. L., & Flug, E. R. The conceptual study of American industry. Improving instruction in industrial education, Twelfth annual industrial education conference, Stout State University, October 1968.

Fox, D. J. The research process in education. Toronto, Holt, Rinehart & Winston, 1969.

Harder, J. D. Industrial arts program and curriculum planning. A paper presented at the Industrial Arts Invitational Conference, Edmonton, June 1967.

Industrial Education Guild. Guild News. 1968, 15(4), 4-13.

Kelley, T. L., Madden, R., Gardner, E. F., & Rudman, H. C. Stanford Achievement Test. New York, Harcourt, Brace & World, 1964.

Kelley, T. L., Madden, R., Gardner, E. F., & Rudman, H. C. Stanford test manual. New York, Harcourt, Brace & World, 1964.

Kerlinger, F. N. Foundations of behavioral research. Toronto, Holt, Rinehart, & Winston, 1964.

Kirby, J. Industriology. Unpublished paper, Wisconsin State University-Platteville, 1967.

Lux, D. G. Curriculum innovations in industrial arts in the secondary schools. A paper presented at the 54th Mississippi Valley Industrial Arts Conference, November, 1967.

Mager, R. F. Preparing instructional objectives. Palo Alto: Fearon, 1962.

Maley, D. Research and experimentation in the junior high school. The Industrial Arts Teacher. 1959.

Maley, D. The Maryland Plan for industrial arts in the junior high school and the behavioral task analysis approach. A paper presented at the National Convention of the American Industrial Arts Association, April 1969.

Maley, D. Industrial arts--A study of industry and technology for contemporary man. Unpublished paper, University of Maryland.

Maley, D. The junior high school program in industrial arts--A study of industry and technology for contemporary man. Unpublished paper, University of Maryland.

Merton, R. K., Fiske, M., & Kendall, P. L. The focussed interview. Glencoe, Free Press, 1956.

Minelli, E. L. The partnership vocational education project. Unpublished paper, Central Michigan University.

Mitchell, J. The Maine State Plan. Unpublished paper, Gorham State College.

National Study of Secondary School Evaluation. Evaluative Criteria. Washington D.C.: NSSSE, 1960.

National Study of Secondary School Evaluation. Evaluative Criteria for the junior high school. Washington D.C.: NSSSE, 1963.

Nelson, O. W. American industry project: Development and evaluation. A paper presented at Curriculum Programs in Action, a conference sponsored by the Center for Technological Education, San Franscisco State College and the Center for Studies in Vocational and Technical Education, University of Wisconsin, February 1967.

Nelson, O. W. The evaluation system for the American industry secondary school courses. A paper presented at the American Vocational Association Convention, December 1968.

Noll, V. H. Introduction to educational measurement. Boston Houghton Mifflin, 1957.

Provus, M. M. The discrepancy evaluation model: An approach to local program improvement and development. Pittsburgh Public Schools. Sponsored by Office of Education, DHEW. Eric # ED 030-957.

Rich, J. Interviewing children and adolescents. Toronto, Macmillan, 1968.

Stake, R. E. The countenance of educational evaluation. Teachers College Record, 1967, 68(7).

Stufflebeam, D. A. position regarding the meaning of educational evaluation. Unpublished paper, Ohio State University, 1967.

Stufflebeam, D. A. Towards a science of educational evaluation. Educational Technology, 1968, 8(14).

Towers, E. R., Lux, D. G., & Ray, W. E. An industrial arts curriculum project for the junior high school. Final report, January 1967, Ohio State University, Project No. 5-0050-2-32, Contract No. OE-5-85-066 Office of Education, Department of Health, Education and Welfare.

Tuckman, B. W., The development and testing of an evaluation model for vocational pilot programs. Rutgers, 1967 Eric # 016-083.

Turnquist, C. H. Galaxy approach to education for the world of work. School Shop, 1965, 25(11), 25-27.

Tyler, R. W. Constructing Achievement tests, Ohio State University, 1934.

University of Alberta. Report of the Board of Governors. Edmonton: U of A, 1961-1962.

University of Alberta. Report of the Board of Governors. Edmonton: U of A, 1962-1963.

Yoho, L. W. The orchestrated systems approach to industrial education. Unpublished paper, Indianna State University 1967.

Yoho, L. W. The systems analysis approach to industrial arts content. A paper presented at the National Convention of the American Industrial Arts Association, 1969.

Ziel, H. R. Interpretating the world of work in an industrial arts program. Industrial Arts and Vocational Education, 1962, 51(7), 26-27.

Ziel, H. R. A new concept of the industrial arts program. Alberta Teachers Association Magazine, 1963, 43(6), 17-21.

Ziel, H. R. The conference method. Edmonton, the University of Alberta, (no date).

Ziel, H. R., Leblanc, D., & Manuel, D. Research report I--Industrial arts in general education, Unpublished brochure, University of Alberta, 1966.

Ziel, H. R., Tichenor, H. D., & Gallagher, J. E. A position paper of the Department of Industrial and Vocational Education. Unpublished paper, University of Alberta, 1965.

APPENDICES

Appendix A

A listing of the commitments made by the Department of Industrial and Vocational Education the Edmonton school systems for the purpose of operating the experimental research program. This compilation is based on an unpublished working paper, prepared by Dr. D. R. Young, entitled "A proposal to review the Department of Industrial and Vocational Education's commitment in IA research to the Edmonton schools."

Commitments made by the
Department of Industrial and Vocational Education to the
Edmonton School Systems

---

1. To provide two co-directors, one associate director (to teach public school students) and one graduate student assistant.
2. To provide all machines, tools, equipment, benches, and all other necessary furniture to completely set up the Phase I and II laboratories. These items were to be on loan without charge for a period of three to five years with the possibility of renewal of agreement.
3. All maintenance, repairs, alterations, etc. of university owned equipment.
4. Curriculum packages including the latest instructional aids developed by the Department.
5. Staff for evaluating the curriculum packages that have been used by the students.

Appendix B

A compilation of previously stated objectives for the experimental industrial arts research program of the Department of Industrial and Vocational Education.

Objectives of the Experimental Research Program

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1. To study the feasibility of the new industrial arts program.
2. To assist in the development of the new industrial arts program in terms of program direction, content, technique and teaching methods, and laboratory design.
3. That the laboratory serve as a model program for the province.
4. To establish norms for content for each instructional area.
5. To discover the effects of industrial arts study on student performance in academic disciplines.
6. To determine advantages and disadvantages of applied teaching methods.
7. To determine advantages and disadvantages of teaching aids.
8. To establish norms with regards to attention span for various groups and various activites.
9. To determine norms with regards to time spans of effective independent activity (without teacher presence).
10. To examine apparent optimal allocations of time for varieties of activities (developing variety in the work load) in light of the advantages and disadvantages of teaching aids and the norms of attention

span with respect to groups and various activities.

11. To determine effectiveness of techniques for building useful evaluation profiles.
12. To determine the nature and extent of created interests and understandings towards the world of work and its multiplicity of occupational opportunities.

<u>Appendix C</u>

The student interview instructions, orientation, and guide.

Student Interview Orientation

Instructions

Read the orientation to the students and discuss any questions they may have. Attempt to create an atmosphere of interest, confidence, and of the worth of their answers and thoughts.

Orientation

1. You are a part of the University of Alberta's Department of Industrial and Vocational Education's experimental research program.

2. This program is basically designed to develop a more interesting and appropriate industrial arts course.

3. Read the objectives for the study from the original copy of the thesis proposal. Emphasize the objective relating to the student interviews.

4. This kind of proposal is required as a part of the master's program. The master's degree program is an advanced program one can take after one obtains a bachelor degree.

5. This proposal was accepted and the study is now being conducted.

6. Student ideas are important. They present a different viewpoint because they are actually taking the course.

7. Every industrial arts class in King Edward JHS and Cartier McGee JHS is being sampled.

8. You are a randomly selected sample of your class. This means that there is no more reason for your selection than anybody else's.

9. Frankness and honesty will be appreciated. No names will be attached to the responses. Your principal and teacher will not be told who said what.

10. All suggestions will be tabled anonymously.

Student Interview Orientation (continued)

11. Any questions you have will be gladly answered at any time.

12. The interview will take about 45 minutes.

<u>Types of instructional material</u>

1.	Audio-tapes	A recorded tape meant to be played on a cassette or reel type tape recorder.
2.	Films	Includes 16mm, 8mm, and cartridge film loops. They may have sound or be silent. They may be in colour or in black and white. They generally project a moving picture.
3.	Filmstrips	A wide (35mm) roll of film, usually with words explaining the picture in the projected picture. Generally requires the advancing of film by hand, one frame at a time.
4.	Models	A replica of something. Can be smaller than the real thing. It may be something that is used to show something about itself.
5.	PPI & SPI	The initials stand for programed pictorial instruction and sequenced pictorial instruction. Generally they are a booklet consisting of pictures and instructions, with a minimum of writing.
6.	Printed materials	Books, pamphlets, and instruction sheets. They mainly consist of printed material with a few diagrams and pictures.

Student Interview Orientation (continued)

7.	Research reports	An assigned or voluntary study of a given topic that results in a written paper or project explaining and describing the topic.
8.	Slides	Generally 35mm pictures that project to show an enlarged picture.
9.	Slide--tapes	A syncronized presentation of a slide with an accompaning audio-tape. The slides may be changed automatically or manually as signaled by a chime.
10.	Television	Any presentation by means of a live commercially broadcast program or by the replay of a recorded video-tape.
11.	Others	Any other type of instructional material that may have been used. Please specify.

Student Interview Guide

Instructional materials

1. Which type(s) of instructional material did you use (most frequently) to learn how to operate machines and tools?

2. Which type(s) of instructional material did you use (most frequently) to learn about the processes basic to industry?

3. Which type(s) of instructional material did you use (most frequently) to learn about jobs, careers, academic and physical requirements, and the working conditions?

4. Which type(s) of instructional material did you use (most frequently) to learn about safety and safe operating procedures?

5. Which type(s) of instructional material did you use (most frequently) to learn about materials and their properties and characteristics?

6. Which type(s) of instructional material did you use (most frequently) to learn how the laboratory was to be operated and organized?

7. Which type(s) of instructional material did you use (most frequently) to learn about industry, labor, unions, organization, and management?

8. Which type(s) of instructional material did you use (most frequently) to learn the basic principles of technology?

9. Which type(s) of instructional material did you use, or were used to interrelate industrial arts areas, or industrial arts with other courses in the school?

10. Which type(s) of instructional material did, or would, you enjoy using the most? Which type(s) of instructional material was most interesting?

11. Which type(s) of instructional material did you find was the most effective for learning what was to be learnt?

Student Interview Guide (continued)

12. Which type(s) of instructional material would you like to see used more often?

Experimental research program

13. Did you know that you were a part of the experimental research program?

14. Did your instructor ever discuss the experimental research program with you or with the class?

15. Were you bothered by the presence of the researchers during the year? Did they interfere with your work?

16. Did you begrudge the time the researchers required of you for research activities such as test, discussions, and interviews?

17. Do you feel that students have ideas that can contribute to industrial arts research?

18. How did you know, how were you told, that you were a part of the experimental research program?

19. What did your instructor say about the experimental research program?

20. How would you change the experimental research program as you know it?

What should be

If you could change things, what would you like to see happen in the industrial arts course, what kinds of things are good that you would like to see more of, and what kinds of things are not so good that you would like to see less of? What should be changed with respect to:

21. the instructor?

22. the physical facilities?

23. the instructional equipment?

24. books and printed materials?

25. instructional materials (other)?

26. products?

Appendix D

The instructor interview instructions, orientation, and guide.

Instructor Interview Orientation

Instructions

Show the thesis proposal and allow enough time to skim or read it. Then give the instructor the opportunity to ask any questions he may have. Discuss the orientation with the instructor and give it to him for the interview.

Orientation

1. The purpose of this study is to obtain more feedback that will benefit future research programs and of course the teacher education program.

2. The study will be used to fill the thesis requirement for the masters program.

3. The questions are aimed at the two year period from 1968-1970.

4. Operational definitions that may clarify the meaning of the questions:

   Instructional equipment encompasses all equipment in the industrial arts laboratory. It includes audio-visual equipment as well as the equipment designed to illustrate processes or to assist in achieving the program's objectives.

   Instructional material is another term for software, and is intended to include all forms of booklets, teaching sheets, spi's, ppi's, films, slides, tapes, video-tapes, and any combination of these.

   Teaching methods are a strategy used for planning the instruction of students or their learning experiences, with the emphasis on teacher activities. Types of methods are:

      Lecture generally characterized by the instructor talking and presenting information to the assembled students. This may be done to classes or groups.

      Demonstrations usually involve the instructor showing, describing, and explaining operations and procedures. This may be to classes or groups.

Instructor Interview Orientation (continued)

Discussion involves the instructor and students in an interchange of ideas and questions about a topic.

Field trips are an excursion away from the school plant, generally to visit an industry, plant or factory.

Audio-visual presentations involve the displaying of information using media such as slides, films, filmstrips as the primary communicator. The term is intended to include presentations of either audio or visual media alone also.

Programed presentations are presentations structured and sequenced for a specific task. The material is generally self administered and paced. Common forms are PPI's, SPI's, and slide-tapes.

Independent study generally involves the use of books and other resources to increase the students knowledge of a given topic. The student usually is responsible to cover the topic with a minimum of further direction. It can take the form of research reports, projects, and problem solving.

Other there are probably other methods that you may know of and may have used. Please include them and specify what they are.

Types of student activity

Learning material information
Learning processes
Learning about jobs, careers, and requirements
Learning machine and tool operation
Learning safety rules and procedures
Learning about business, organization, labor
Learning principles of technology
Interrelating industrial arts with other courses
Learning the laboratory organization
Product making

Instructor Interview Guide

Instructional materials

1. During the past two years of the experimental industrial arts program (EIAP) did you use spi's? If so, for which type(s) of student activities?

2. Did you use slides? If so, for which type(s) of student activity?

3. Did you use television? If so, for which type(s) of student activity?

4. Did you use films? If so, for which type(s) of student activity?

5. Did you use models? If so, for which type(s) of student activity?

6. Did you use books and other printed material? If so, for which type(s) of student activity?

7. Did you assign research reports? If so, for which type(s) of student activity?

8. Did you use filmstrips? If so, for which type(s) of student activity?

9. Did you use audio-tapes? If so, for which type(s) of student activity?

10. Did you use syncronized slide-tape presentations? If so, for what type of student activity?

11. Did you use any other type of instructional materials not mentioned here? If so, specify, and for which type(s) of student activity did you use them?

12. Based upon your experience in the past two years, what are your findings about the uses, effectiveness, disadvantages and problems of each of the above mentioned instructional materials?

Instructional equipment

In each of the following blanks (questions 13-17) insert the areas appropriate to the laboratory concerned.

Instructor Interview Guide (continued)

Phase I--woods, metals, plastics, graphic arts, ceramics, materials testing, electricity

Phase II--graphic communications, photography, electronics-computers, power mechanics

13. With respect to the _____ area, what equipment was most effective in terms of durability, safety, student interest, and representativeness?

14. With respect to the _____ area, what equipment was least effective in terms of durability, safety, student interest, and representativeness? (required frequent repairs, adjustments, intricate maintenance, elaborate safety procedures, awkward instruction)

15. With respect to the _____ area, what equipment would you like to see added?

16. With respect to the _____ area, what equipment would you like to see removed?

17. With respect to the _____ area, what equipment would you like to see modified, and what are these modifications?

18. What other comments have you about the equipment in the laboratory that you have not yet mentioned?

Teaching methods

In the following blank (question 19) insert each of the activities listed, one at a time.

Activities

Machine and tool operation
Processes basic to industry
Safety precautions
Jobs, careers, requirements
Materials, characteristics, properties
Business, labor, organization
Industrial arts interrelationships
Industrial arts laboratory organization
Principles of technology

19. For the instruction of (about) ___________, which teaching methods did you use?

Instructor Interview Guide (continued)

20. Did the laboratory arrangement determine the teaching methods used? Perhaps vice-versa? If so, how?

21. Did the instructional equipment determine the teaching methods used? Perhaps vice-versa? If so, how?

Student achievement

22. What system did you use to determine a student's overall standing for report marks?

23. What methods did you use to assess the gross knowledge of facts, details, and procedures?

24. How did you assess the student's understanding of ideas, concepts, and principles?

25. How did you evaluate student products and/or experiments.

26. Were there any other evaluative techniques and methods used but not already mentioned? What were they?

Experimental research program

27. How did you become aware of the University of Alberta's Department of Industrial and Vocational Education's experimental research program?

28. How did you become one of the instructors in the experimental research program?

29. Who do you feel was instrumental in establishing the experimental research program in the Edmonton school systems?

30. With respect to the experimental research program, what committments were made to you:

    a. by the Department of Industrial and Vocational Education? Who? When?

    b. by the school board? Who? When?

    c. by your school administration? Who? When?

31. Were these committments kept? If not, which were not kept? Do you know (or guess) why not?

Instructor Interview Guide (continued)

32. How was the experimental research program implemented at your school?

33. During the experimental research program, did the investigators from the university by watching, working, and discussing problems, interfere with your instructing of the course? If so, how?

34. What do you feel are the most useful outcomes of the experimental research program?

35. What do you feel are the least useful aspects of the experimental research program?

36. With respect to the experimental research program, what would you have changed or done in another manner, using the past two years as a guide?

37. How do you feel about the experimental research program being discontinued in its present form?

Appendix E

The industrial arts achievement test.

PHASE I AREA PRE-TEST

The test is composed of selected questions that attempt to evaluate in a small way the students knowledge of the more common aspects of a particular area. The questions are the work of many industrial arts students during the course of their university program. As such the questions were not designed with the purposes of a pre-test in mind, but it is hoped by the writer that his selection of the particular questions used enables them to function in an assessing capability.

QUESTIONS

1. Pottery will hold water:

   a) indefinitely
   b) for a short time only
   c) indefinitely when fired in a kiln
   d) not at all

2. Newspapers mostly use which method for duplicating plates:

   a) electrotyping
   b) linotyping
   c) sterotyping
   d) typing

3. Many of man's historical advances can be related to:

   a) the clothes he wore
   b) the birth of a genius
   c) the discovery of a new metal and its use
   d) luck

4. A list of ingredients required to make a fiberglass product includes:

   a) glass fibres and resin
   b) glass fibres and resin and catalyst
   c) glass fibres and plastic
   d) glass fibres and resin and catalyst and dye

5. AC current flows:

    a) in one direction only
    b) in alternate directions only
    c) does not flow at all
    d) cannot be determined

6. Plastics can be:

    a) cast
    b) formed
    c) welded
    d) all of these

7. The basic principle of off-set printing is that:

    a) ink will adhere to a raised surface
    b) ink and water will not mix
    c) oil and water will not mix
    d) ink may be picked up from an indentation

8. Modern domestic wiring is protected from overload by:

    a) a rheostat
    b) a DPDT switch
    c) a DPST switch
    d) a circuit breaker

9. Ceramic ware in the finished state is usually:

    a) brittle
    b) ductile
    c) porous
    d) malleable

10. If lumber is not properly dried:

    a) it cannot be used
    b) it will shrink and warp if used
    c) it is much heavier
    d) it should be kiln dried

11. Common processes in the plastics industry are:

    a) blow and vacuum forming
    b) sintering and chipping
    c) inversion and freezing
    d) all of these

12. A battery produces electricity by means of:

    a) heat
    b) chemical action

c) light
d) magnetism

13. The electron is:

a) the nucleus of the atom
b) the positive particle of the atom
c) the neutral part of the atom
d) the smallest particle of an atom having a negative charge

14. DC means:

a) amperes
b) voltage
c) direct current
d) alternating current

15. Ohms law states that:

a) the resistance is equal to the voltage divided by the capacitance
b) the resistance is equal to the voltage divided by the current
c) the current is equal to the resistance divided by the voltage
d) the voltage is equal to the current divided by the resistance

16. The unit by which electrical bills are computed is:

a) the watt
b) the watt-hour
c) the killowatt-hour
d) the kilowatt

17. The difference between sheet metal and machine metals:

a) the dimensions
b) the metallic content
c) the specific gravity
d) the material

18. An electrical motor changes electrical energy into:

a) physical energy
b) static energy
c) chemical energy
d) mechanical energy

19. Plywood sheets are normally:

a) 4' x 4'

b) 4' x 16'
c) 4' x 42'
d) 4' x 8'

20. The spokeshave, drawknife, chisel and handplane are handtools used for:

a) turning
b) sawing
c) scribing
d) shaping

21. The local plastics industry is approximately:

a) ten years old
b) twenty years old
c) fifty years old
d) two years old

22. The two major types of plastics are:

a) fluoride and chloride based
b) thermoplastics and thermosets
c) rigid and flexible plastics
d) solid and foamed plastics

23. Cells in series, multiply the:

a) negative cells
b) positive cells
c) number of cells
d) emf

24. The cutting of wood to desired shapes using a rotating cutter on a machine is called:

a) sawing
b) scraping
c) shaping
d) chiseling

25. Exclusion of ________________ from a light bulb enables the filament to get white hot without burning out.

a) oxygen
b) gas
c) light
d) hydrogen

26. A photocell converts:

a) mechanical energy into electrical energy
b) light energy into electrical energy
c) electrical energy into light energy
d) electrical energy into kinetic energy

27. Which machine is not normally used in the ceramics industry:

a) the potters wheel
b) automatic jiggering machine
c) extruders
d) injection press

28. Abrasives can be:

a) man-made
b) natural
c) diamond
d) all of these

29. Coniferous trees are those that have:

a) needles
b) broad leaves
c) hard wood
d) diseases

30. Common ceramic products are:

a) tile
b) bricks
c) curtains
d) only a and b

31. The magnetic field surrounding the conductor is the result of the:

a) resistance of the wire
b) insulation covering the wire
c) current flow through the wire
d) none of these

32. The age of a tree can be determined by counting its:

a) knots
b) annual rings
c) medullary rays
d) branches

33. Like poles:

a) repel each other
b) attract each other

c) don't do anything
d) have an undetermined effect

34. Plywood of equal thickness compared to spruce lumber is:

a) stronger
b) weaker
c) equally as strong
d) much weaker

35. Softwoods are mostly used in:

a) house construction
b) furniture
c) airplanes
d) automobiles

36. The two main grades in softwood are:

a) select and common
b) A and B
c) C and D
d) indicated by letters and numbers

37. The unit used in the measurement of electrical resistance is:

a) the watt-hour
b) the volt
c) the ohm
d) the ampere

38. Charcoal is made by heating wood:

a) in the presence of ammonia
b) in the absence of air
c) in an acidic solution
d) for fifteen minutes

39. Cellulose, which is a by-product of wood, is not used to make:

a) rayon
b) wall boards
c) sausage casing
d) artificial sponge

40. Lamination is a process used for making:

a) pieces of wood
b) large pieces of wood
c) pieces of wood which are glued in layers
d) furniture

41. Which is not a common metal fabricating process:

    a) riveting
    b) soldering
    c) plating
    d) welding

42. Which is used to make the finest paper such as writing paper and note paper:

    a) pulp
    b) rag fibre
    c) pulp and rag fibre
    d) china clay

43. Compared to case iron, plastics in general are:

    a) more ductile
    b) more malleable
    c) weaker in compression
    d) all of these

44. An electrical current is a movement of:

    a) electrons
    b) protons
    c) neutrons
    d) both electrons and neutrons

45. A substance is considered to be a conductor when it:

    a) possesses extremely high resistance
    b) possesses only balanced atoms
    c) retains its electrons firmly
    d) does not retain its electrons readily

46. Which does not convert mechanical energy into electrical energy:

    a) generator
    b) alternator
    c) dynamo
    d) carburetor

47. Which area of a board does a thickness planer plane:

    a) edges
    b) surfaces
    c) ends
    d) edges, top and the end

48. The area of ceramics involves:

    a) clay and concrete
    b) glass and enamels
    c) abrasives
    d) all of the above

49. Which of the following would increase the resistance of a conductor:

    a) a change in the material of the conductor from copper to silver
    b) an increase in the cross-sectional area of the conductor
    c) a decrease in the temperature of the conductor
    d) an increase in the length of the conductor

50. Voltage is a word used to describe:

    a) watts
    b) ohms
    c) pressure
    d) resistance

51. Frequency means:

    a) how frequently a capacitor discharges
    b) how frequently a battery is recharged
    c) the resistance of a wire to current
    d) how frequently a generator produces a complete cycle

52. Intaglio refers to:

    a) printing from a raised surface
    b) printing from a sunken surface
    c) printing done in Italian script
    d) the use of a silk

53. Miniature electrical systems make extensive use of:

    a) vacuum tubes
    b) hand wired circuitry
    c) printed circuits
    d) alligator clips

54. Wood turning is associated with the:

    a) band saw
    b) circular saw
    c) lathe
    d) shaper

55. Common characterisitcs of metals are:

a) ductility and malleability
b) shine and the ability to take a polish
c) a high strength to weight ratio
d) all of these

56. If a permanent magnet is broken into a number of pieces:

a) each piece becomes a magnet
b) all the magnetism is lost
c) some pieces are magnetic others are not
d) none of the above

57. A board foot of lumber is a piece:

a) 12" x 12" x 12"
b) 12" x 1" x 1"
c) 12" x 1" x 12"
d) 6" x 6" x 1"

58. Which is not an example of heat-treating a metal:

a) annodizing
b) annealing
c) tempering
d) case hardening

59. Industry uses shaper machines to manufacture:

a) lumber
b) door and window moldings
c) pickets
d) planks

60. The most important sources of metal are:

a) in pure metallic form
b) in the form of metallic ore
c) in the form of powder
d) in the form of liquid

61. Ceramic glazes are used to:

a) coat paper
b) give a gloss to pottery
c) seal clay items against air leaks
d) all of these

62. Raw materials for plastics may be:

a) milk
b) oil and gas

c) wood
d) all of these

63. A schematic drawing represents:

a) the circuit
b) the plane
c) the matrix
d) the job

64. Measuring tools commonly used with woods are:

a) try square
b) marking gauge
c) ruler
d) all of these

65. Wood must be dried to suit the humidity conditions under which it is to be used:

a) before it is graded
b) before it is sold
c) to prevent warping and shrinking
d) to reduce shipping weight

66. When laminating wood together, it is placed with grains alternating so that:

a) it is stronger
b) when it warps it counteracts
c) it is easier to assemble
d) it looks nicer

67. Common names for plastics are:

a) styrenes
b) polyethylenes
c) epoxies
d) all of these

68. The matrix of a rubber stamp has:

a) a type impression which cannot be read because it is inverted
b) a positive impression which can easily be read
c) a positive and raised surface
d) a flat surface with no type impression until pressed to rubber

69. The type set for the platen press may be read as such:

a) by using a mirror
b) by reading as you would normally

c) by reading the type from the bottom up
d) only after it has been printed

70. In a series circuit:

a) the total resistance is equal to the sum of the individual resistors
b) the current is not the same in all parts
c) the current is proportionate to the resistance
d) the current is inversely proportionate to the voltage

Appendix F

A sample page from the equipment comparison device.

EQUIPMENT COMPARISON

School King Edward Area Woods Date June 29, 1970

Quant.	Department of Education Recommendation	In the Laboratory	Comments and Explanation
Hand tools			
2	Scratch awls	Y	
1	Bit, expansive, 7/8-3/8	Y	
1	Set bits, forstner, 3/8, 1/2, 3/4, 1	Y	
4	Bench brushes	Y	
	....		
Power tools, machines, equipment			
1	Drill pres, 15", bench, c/w jacobs chuck, belt guard, 1/2 HP motor, push button switch, 3" sanding drum	Y	Except for sanding drum
2	Dust collectors, 2" hose, accessories to adapt to machines and for clean up on casters	-------	Only one vacuum cleaner is provided, with hose but no accesories or casters
	....		
Equipment beyond Department of Education recommendations			
1	Vega Dia-press, laminating machine		
	....		